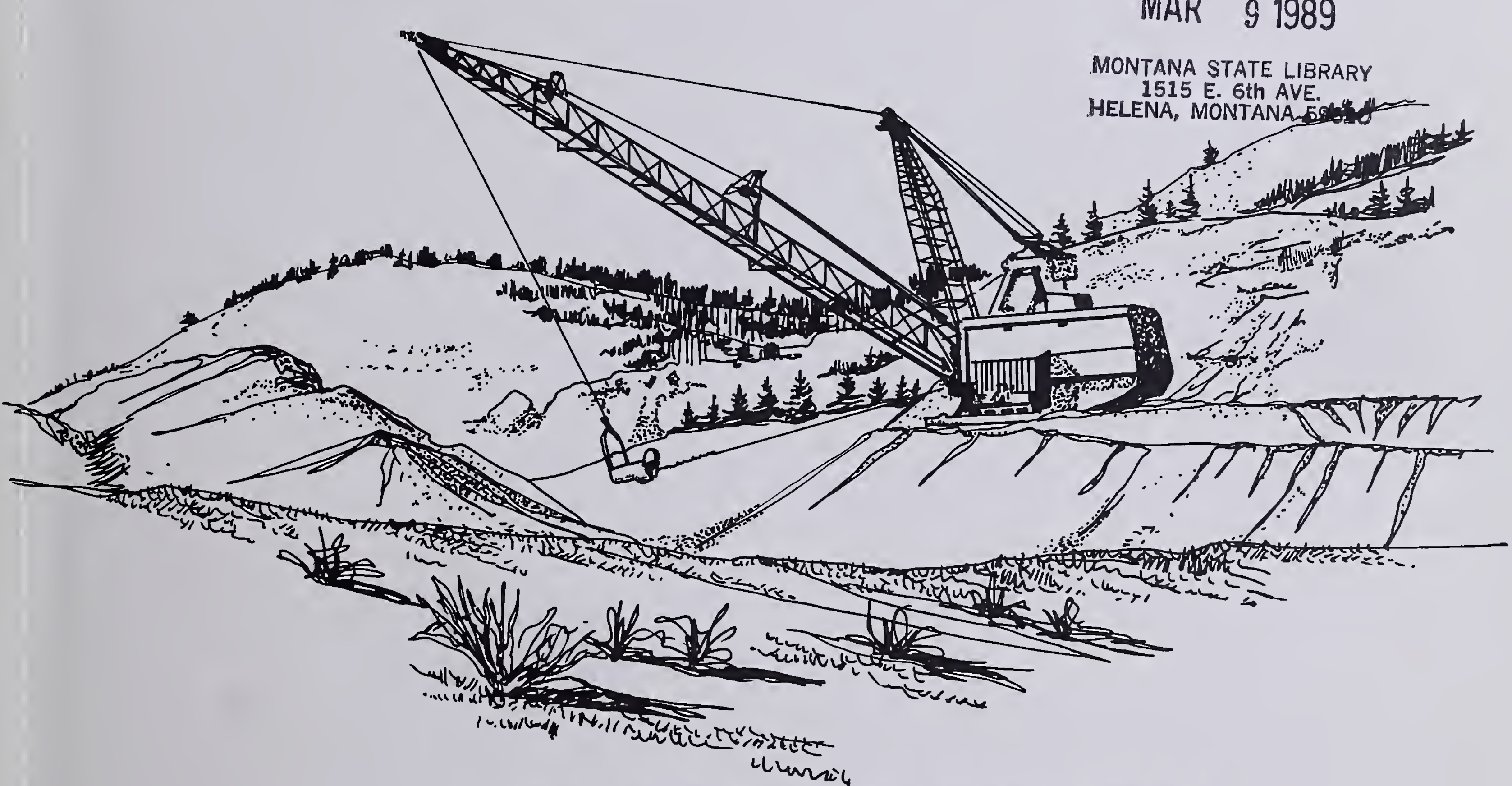
Draft Environmental Impact Statement
Peabody Big Sky Mine - Area B
Rosebud County, Montana



Montana Department of State Lands
U.S. Office of Surface Mining Reclamation and Enforcement
OSM-EIS-26

COVER SHEET

TYPE OF STATEMENT

Draft Environmental Impact Statement

LEAD AGENCIES

State of Montana, Department of State Lands
U.S. Department of the Interior, Office of Surface Mining
Reclamation and Enforcement

COOPERATING AGENCY

U.S. Department of the Interior, Bureau of Land Management

PROPOSED ACTION

Approval to mine 3,064 acres (3,200 acres of total disturbance) at Peabody Coal Company Big Sky Area B Mine

MORE INFORMATION

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Draft

Environmental Impact Statement

PEABODY COAL COMPANY'S

BIG SKY AREA B MINE

Rosebud County, Montana

July 1988

Montana Department of State Lands
Dennis Hemmer, Commissioner

U.S. Office of Surface Mining Reclamation
and Enforcement
Robert Gentile, Director

SUMMARY

This Environmental Impact Statement (EIS) identifies and analyzes the probable impacts to the quality of the human environment that would result should the Secretary of the U.S. Department of the Interior (Secretary), the Federal Programs Division Chief (Division Chief), and the Commissioner of the Montana Department of State Lands (Commissioner) approve the mining proposal for, and the Peabody Coal Company (Peabody) subsequently develops, the proposed Big Sky Area B Mine. The EIS also identifies and analyzes probable cumulative impacts that would result from surface coal mining operations at permitted and proposed coal mines in the region.

BRIEF DESCRIPTION OF THE PROPOSAL

Peabody proposes to expand operations of the existing Big Sky Mine into Area B of the Lee Coulee drainage in Rosebud County, Montana, near the community of Colstrip. The total projected disturbance area of the proposed Area B extension is about 3,200 acres. The average annual production rate would be approximately 2.8 million tons, with a maximum possible production of 4 million tons per year.

PURPOSE AND NEED OF THE STATE AND FEDERAL ACTION

Peabody has submitted permit application packages to the Office of Surface Mining and Reclamation Enforcement (OSMRE) and the Montana Department of State Lands (DSL) to mine coal at the proposed Big Sky Area B Mine. Therefore, under the Mineral Leasing Act of 1920, as amended, the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and the Montana Strip and Underground Mine Reclamation Act (SUMRA), passed in 1973, the Secretary, the Division Chief, and the Commissioner must approve, disapprove, or conditionally approve the mining proposal submitted by Peabody. This EIS identifies and analyzes probable environmental consequences of development that may result from the State and Federal actions or decisions.

Decisions that could be made by the Secretary, the Division Chief, and the Commissioner are: to approve the proposed mining proposal with conditions to ensure compliance with Federal and State regulations (Alternative 2); to approve the proposed mining proposal as modified in Alternative 2 but with additional coal conservation conditions included (Alternative 3); and to disapprove the proposed mining proposal to mine coal (Alternative 4). OSMRE and DSL have chosen Alternative 3 as its "preferred alternative." No decision would be made by the Secretary, the Division Chief, or the Commissioner on the mining proposal (Alternative 1) because the proposal does not meet the minimum requirements of SMCRA and SUMRA.

COMPARISON OF ALTERNATIVES

OSMRE's and DSL's analyses found that:

--significant fiscal impacts to Rosebud County would occur under Alternative 4 (disapproval of the mining plan). If the Big Sky Area A Mine were to close after 1990, the gross proceeds tax payments would cease and property tax payments would decrease dramatically.

--impacts that would have the potential to become significant under Alternative 4 include those to employment, income, population, and social life in Rosebud County. Rosebud County would lose basic jobs and secondary sector business and public service development would decrease; personal earnings by county residents would decrease by an estimated $6 million; the Forsyth and Colstrip areas would lose an estimated 300 to 400 people; and life-styles of laid-off workers would be disrupted and the standard of living would be reduced.

--moderate impacts could be expected to occur to: ground and surface water (Alternative 1); aquatic life (Alternative 1); a rare plant species (Alternative 1); mule deer (Alternatives 1, 2, 3, and cumulative); land use (Alternative 1); cultural resources (Alternative 1); natural and spiritual qualities of the environment for the Northern Cheyenne (Alternatives 1, 2, and 3 and cumulative).

--minor impacts could be expected to occur to: ground and surface water (Alternatives 2 and 3 and cumulative); soils (Alternative 1); plant communities (Alternative 1); wildlife (Alternative 1); fiscal impacts (Alternatives 1, 2, and 3); employment (Alternatives 1, 2, and 3); income (Alternatives 1, 2, and 3); population (Alternatives 1, 2, and 3); social life (Alternatives 1, 2, and 3); land use (Alternatives 2 and 3); transportation (Alternatives 1, 2, and 3); cultural resources (Alternatives 2 and 3); aesthetics (Alternatives 1, 2, and 3); noise (Alternatives 1, 2, and 3).

—under Alternative 4, no impacts are expected to occur to: surface and ground water, aquatic life, soils, vegetation, wildlife, land use, cultural resources, and aesthetics.

--positive impacts under Alternative 4 could be expected to occur to air quality, transportation, and noise.

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CHAPTER I:
INTRODUCTION

Peabody Coal Company (Peabody) proposes to expand the Big Sky Coal Area A Mine into the Area B-Lee Coulee drainage, about 6.5 miles south-southwest of Colstrip in Rosebud County, Montana. The proposed expanded mining area is located immediately southwest of the current mine. Before expanding operations, Peabody must obtain a surface mining permit from both the Montana Department of State Lands (DSL), in accordance with the Montana Strip and Underground Mine Reclamation Act, and the U.S. Department of the Interior-Office of Surface Mining Reclamation and Enforcement (OSMRE), in accordance with the Surface Mining Control and Reclamation Act. The applicant also must receive approval of the proposed mining plan by the Assistant Secretary of the Department of the Interior (Secretary) in accordance with the Mineral Leasing Act of 1920.

THE EIS

DSL and OSMRE have determined that the proposed mining and reclamation plan significantly affects the quality of the human environment. Therefore, before making a decision on the company's permit application package, the agencies are required to prepare an environmental impact statement (EIS) in accordance with the Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act of 1969 as amended (NEPA). This procedure includes issuing this draft EIS and encouraging and accepting public comments. If substantial corrections or clarifications to the draft EIS are not necessary, an abbreviated format may be used for the final EIS.

After publication of the final EIS, the agencies must make a decision on Peabody Coal Company's application. DSL can make a decision no sooner than 15 days following publication of the final EIS; OSMRE and the Secretary can make a decision no sooner than 30 days following publication of a notice by the U.S. Environmental Protection Agency (EPA) that the final EIS is available to the public.

The EIS evaluates the effects to the human environment that the Peabody project would have during operation, in combination with other activities that may affect the area, and after the mine closes. The EIS provides the public a forum for comment on the agencies' analysis of the applicant's plan. The preparation of the EIS helps assure that the proposed operation is well planned, that the major environmental impacts of the proposed action are analyzed, and that the concerns of agencies, organizations, and citizens are considered before a decision is made.

HISTORY AND BACKGROUND

Peabody began coal mining in Area A of the Big Sky Mine in the late 1960s and has been in continuous operation since then. The initial operations were regulated by the Montana Department of Natural Resources and Conservation. On December 18, 1973, the first formal mining and reclamation permit (#73004) was issued by DSL. By 1989, all economically recoverable coal will have been removed from the current mining area (Area A). Under the proposal being analyzed, Peabody would shift existing coal production activities to Area B to replace Area A production.

The total permitted acreage of Area A is 2,654.7 acres. Through May of 1988, the total amount of coal produced from the Big Sky Mine has been approximately 44,255,000 tons at an average of 2.8 million tons per year. Operations under the proposal would add 23 years of mining, 64 million tons of coal production, and 5,435 permitted acres to the Big Sky Mine.

OTHER COAL MINING ACTIVITIES

Western Energy Company operates the Rosebud Mine north of the Big Sky Mine. This is a large mining operation centered around the town of Colstrip which over the last 5 years has produced an average of about 12 million tons of coal per year. The Rosebud Mine currently consists of approximately 13,930 permitted acres and 9,315 additional acres are proposed to be permitted under pending applications. The Absaloka, Decker, and Spring Creek mines are operating in the general southeastern Montana region. The Montco, CX-Ranch, Wolf Mountain, and Greenleaf-Miller mines have been proposed for development. The Tongue River Railroad has been proposed for construction to serve the proposed Montco Mine. Figure I-1 shows all the active and proposed mines in the region.

SCOPE OF THE ANALYSIS

The EIS analysis for Peabody Coal Company's proposal to extend mining into Area B-Lee Coulee includes:

--Site-specific analyses of the Area B proposal.

--Site-specific analyses for the proposed Area B-Lee Coulee life-of-mine as it would affect the proposed 5,435-acre permit area, areas immediately adjacent to the permit area, and the region as a whole.

--Cumulative analyses of the life-of-mine scenarios for the existing Big Sky Mine Area A; the proposed Big Sky Mine Area B; Western Energy Company's Rosebud Mine; the other three existing and four proposed mines in the region; and the proposed Tongue River Railroad. The cumulative analysis addresses the hydrology, wildlife, air quality, topography, and socioeconomics of proposed mines and industrial activities as well as to modifications of existing mines in the area.

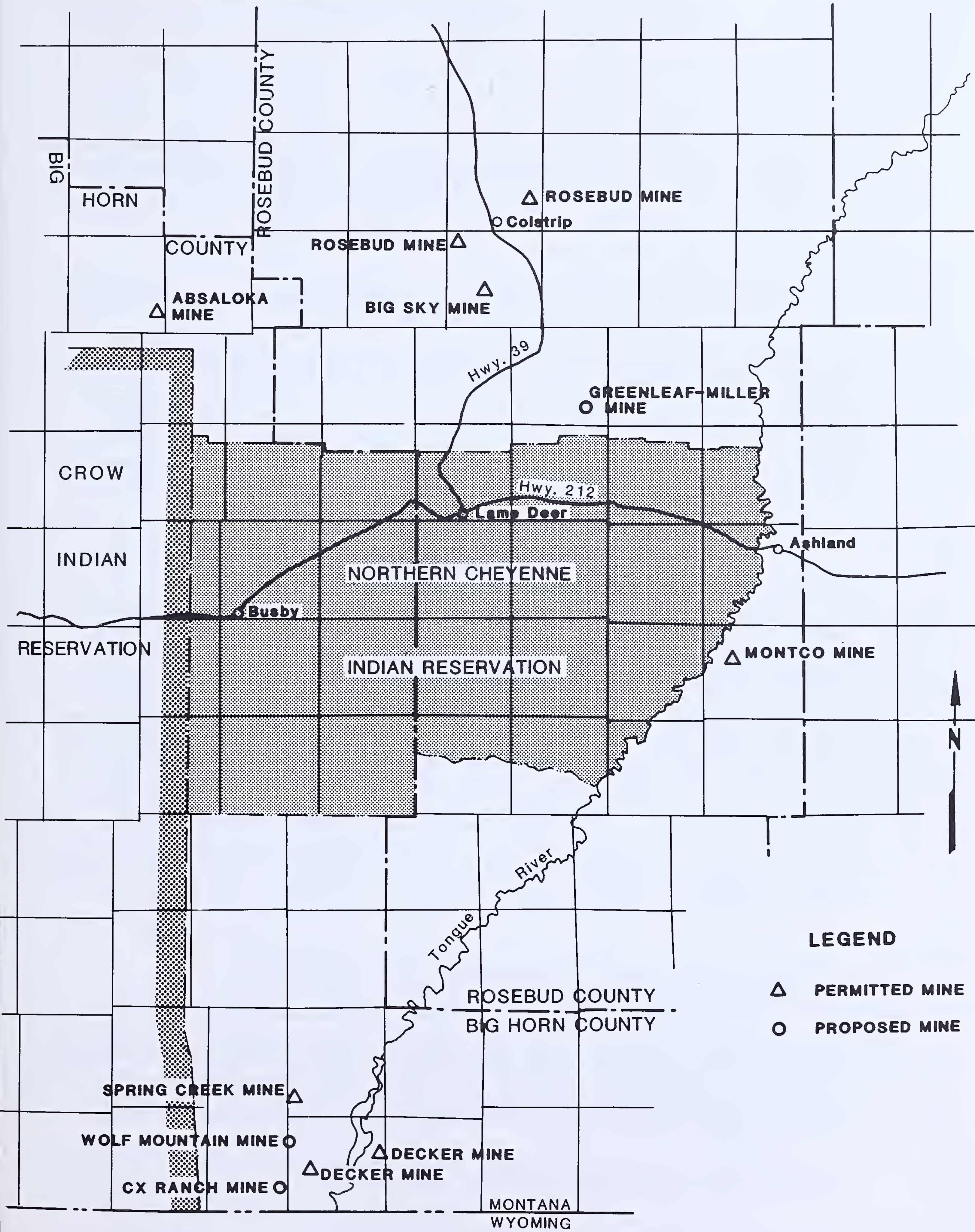


FIGURE I-1

Permitted and Proposed Mines

Special consideration has been given to the Northern Cheyenne Reservation due to their large involvement in the regional socioeconomic framework of southeastern Montana.

Issues Relating to the Proposed Action

--Potential geologic instability of bluff extensions (i.e., partially retained highwalls extending existing bluffs).

--Potential inability of postmining water developments to support the proposed postmining land use.

--Potential ability to recreate the Lee Coulee hydrologic system.

--Potential for migration of total dissolved solids (TDS) in reclaimed overburden.

--Potential for reestablishment of rare plants.

--Conservation of coal on adjacent properties.

AGENCY RESPONSIBILITIES

Montana Department of State Lands

The Montana Strip and Underground Mine Reclamation Act (SUMRA), passed in 1973, requires that a company intending to remove coal first obtain a permit from DSL. In its permit application, a company must submit a plan that meets the act's requirements for protection of environmental and cultural resources in and around the proposed minesite. For instance, the plan must show that the company would salvage and replace all soil; restore the mined land to the approximate premining contour; plant a permanent and diverse cover of vegetation composed of predominantly native species; protect alluvial valley floors; and preserve the hydrologic functions (such as subirrigation) of valleys.

U.S. Department of the Interior - Office of Surface Mining Reclamation and Enforcement

In 1977, Congress passed the Surface Mining Control and Reclamation Act (SMCRA), which is administered by OSMRE. Under SMCRA, DSL developed a "permanent regulatory program," and the Secretary delegated to DSL the responsibility for regulating mining on private and Federal lands. In Montana, OSMRE and DSL both issue permits to mine coal on Federal lands.

Although the Secretary has thus delegated his primary regulatory authority, he cannot, under SMCRA or the Mineral Leasing Act, delegate his

responsibility to approve mining plans, carry out the provisions of NEPA, or to comply with other laws, regulations, and executive orders pertaining to coal mining. Moreover, even though DSL is now the principal agency regulating coal mining in Montana, OSMRE retains oversight responsibility to ensure regulatory program compliance with SMCRA. As part of its responsibility under NEPA, OSMRE jointly prepared this EIS with DSL.

U.S. Department of the Interior - Bureau of Land Management (BLM)

BLM has the responsibility to ensure the proposed resource recovery and protection plan achieves maximum economic recovery of the Federal coal resource; to ensure the proposed postmining land use of Federal surface lands is compatible with Federal programs; and to enforce the terms and conditions of the Federal lease. BLM concurrence with the recommendation for the Secretary's decision on the proposed mining plan is required by the Mineral Leasing Act of 1920, as amended. BLM is participating as a cooperating agency on this EIS.

Montana State Historic Preservation Office (SHPO)

SHPO has the responsibility to cooperate with and advise DSL when potentially valuable historical, archaeological, or other cultural resources are located within a project site (Montana Strip and Underground Mine Reclamation Act [82-4-201 through 82-4-228, MCA], the Montana Antiquities Act [22-3-401 through 22-3-442, MCA], and the National Historical Preservation Act [P.L. 89-665 as amended and reauthorized E.O. 11593]). SHPO seeks a determination from the Keeper of the National Register for sites believed to be eligible for listing in the National Register of Historic Places, and comments on a company's plan for mitigating impacts on such sites. The office also reviews the EIS to ensure compliance with cultural resource regulations. During mine operations, DSL is responsible for monitoring compliance with historic preservation plans.

Montana Department of Health and Environmental Sciences (DHES)

Air Quality Bureau

The Air Quality Bureau of DHES administers the Montana Clean Air Act. Any proposed project that has the potential to emit more than 25 tons per year of any pollutant must obtain an air quality permit before beginning construction. The Bureau reviews emission control technologies to be used by the applicant, who must demonstrate that the project will not violate State or Federal ambient air quality standards. For the expansion into Area B, Peabody must obtain an alteration to its existing air quality permit.

Water Quality Bureau

The Water Quality Bureau of DHES is responsible for administration of the Montana Water Quality Act. This State law provides a framework for the classification of surface water. It also establishes surface water quality standards as well as permit programs to control the discharge of pollutants into State waters.

Montana Department of Natural Resources and Conservation (DNRC)

The DNRC administers the Montana Water Use Act. Peabody must acquire all necessary water use permits and water rights before mining begins.

U.S. Department of the Interior - Fish and Wildlife Service (USFWS)

USFWS administers the Endangered Species Act, as reauthorized in 1982, and the Bald Eagle Protection Act of 1940 (as amended). Where a project is proposed in an area that threatened or endangered species could occur, OSMRE must prepare a biological assessment to comply with the Endangered Species Act. If the assessment determines the project would adversely affect threatened or endangered species, OSMRE must consult with USFWS to establish measures that will protect the affected species.

CHAPTER II:
BIG SKY MINE AREA B

THE APPLICANT'S PROPOSAL

The entire permit application package submitted by Peabody is considered the proposal. This package is available for public review at the following locations:

--DSL offices - Helena and Billings, Montana.

--OSMRE - Casper Field Office - Casper, Wyoming.

--OSMRE - Western Field Operations - Denver, Colorado.

--Rosebud County Courthouse - Forsyth, Montana.

For clarification, the following description of Alternative 1 has been included for informational purposes and reference to subsequent alternative descriptions. As proposed, the Peabody plan does not meet the minimum requirements of SMCRA or SUMRA and could not be selected by the agencies.

Peabody originally applied to DSL in December 1985 for permission to expand its mining and reclamation operations at the Big Sky Mine into a new area known as Area B-Lee Coulee. A revised application for the project was submitted in October 1987. The Big Sky Mine is in the south-central portion of Rosebud County, Montana, about 120 miles east of Billings and 6.5 miles south-southwest of Colstrip (figure II-1). Area B is immediately southwest of the present mine known as Area A. Area B is projected to become operational in 1989, when the last of the coal in Area A is removed.

The proposed permit area includes 5,435.8 acres of land in all or parts of Sections 23, 24, and 25 in T1N, R40E; and Sections 19, 21, 22, 27, 28, 29, 30, 31, 32, and 33 in T1N, R41E. The proposed permit area would accommodate all anticipated mining disturbance in the upper Lee Coulee and Fossil Fork areas plus future expansions of the mine to the southeast down Lee Coulee. Total projected disturbance is about 3,200 acres.

Mining in Area B would occur over a 23-year period plus 2 years for final reclamation. Peabody and Burlington Northern Railroad own the land inside the permit boundary with the exception of approximately 160 acres (SW1/4, Section 32) owned by the Federal government (figure II-2). Coal in the permit area is owned by Meridian Minerals and the Federal government (figure II-3). Peabody has acquired leases for the coal from the owners. The area of Federal coal ownership is approximately 2,557 acres.

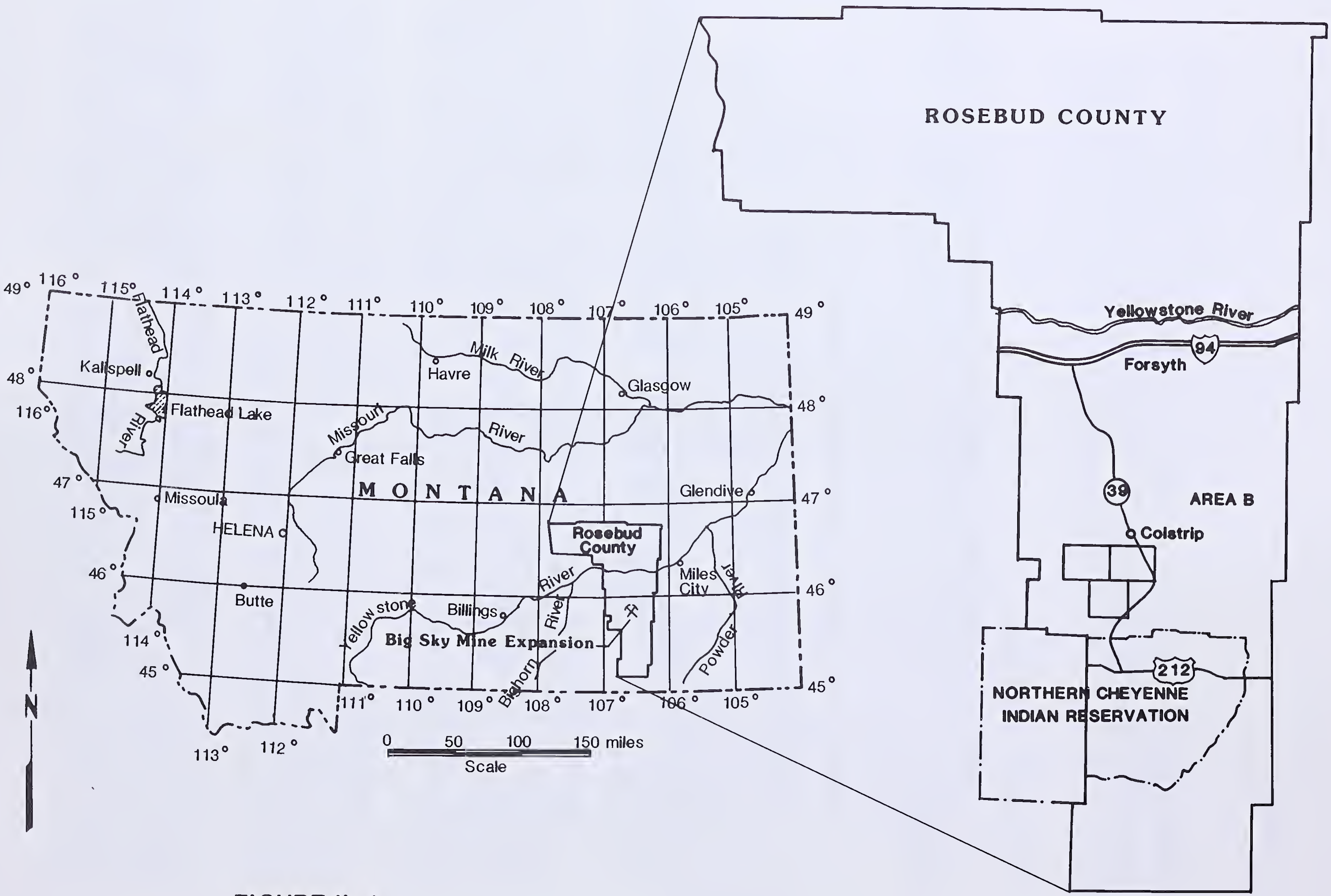
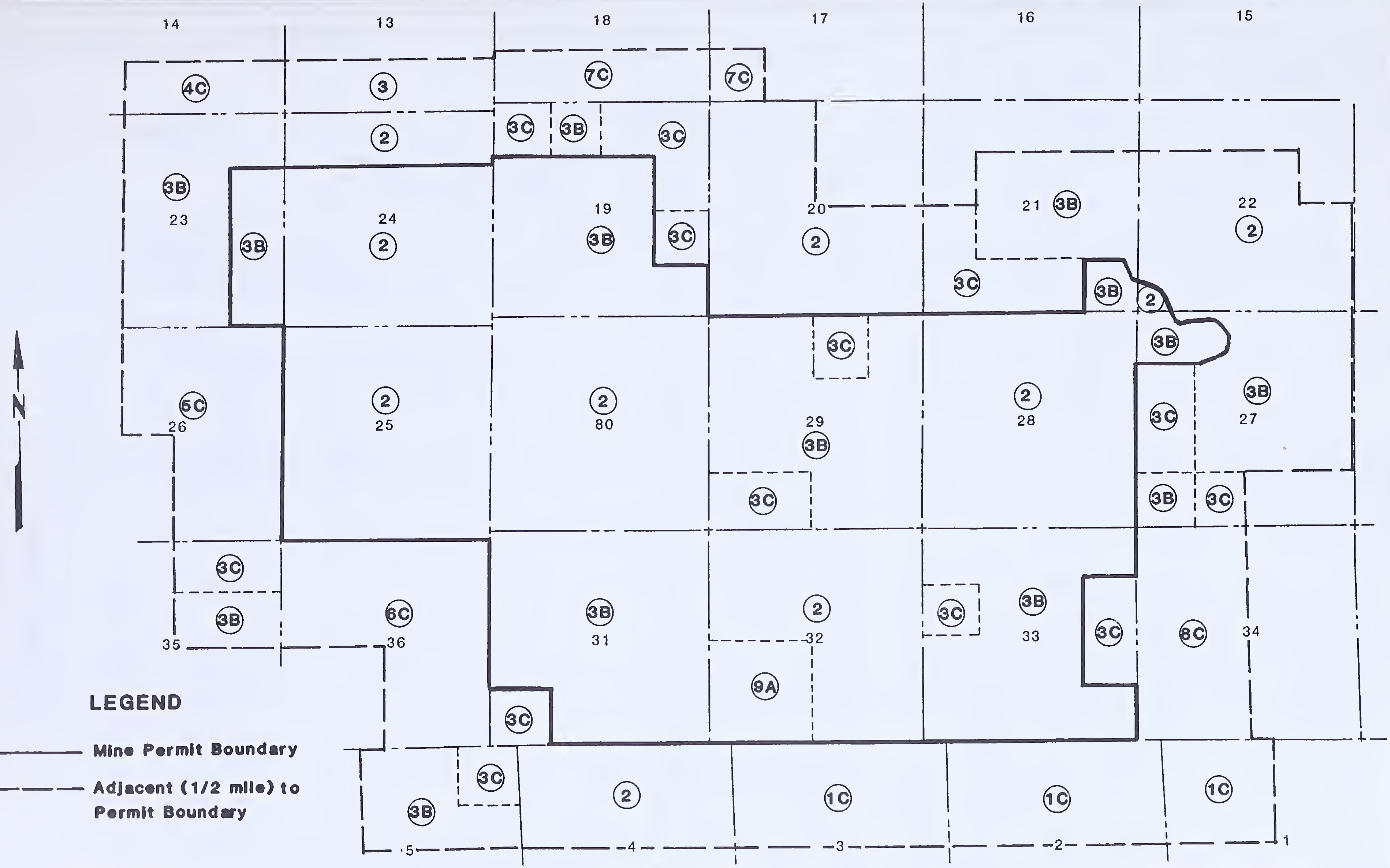


FIGURE II-1

General Location, Big Sky Mine, Area B



LEGEND

Mine Permit Boundary

Adjacent (1/2 mile) to Permit Boundary

FIGURE II-2

Surface Ownership/Surface Lessees

SURFACE OWNERSHIP

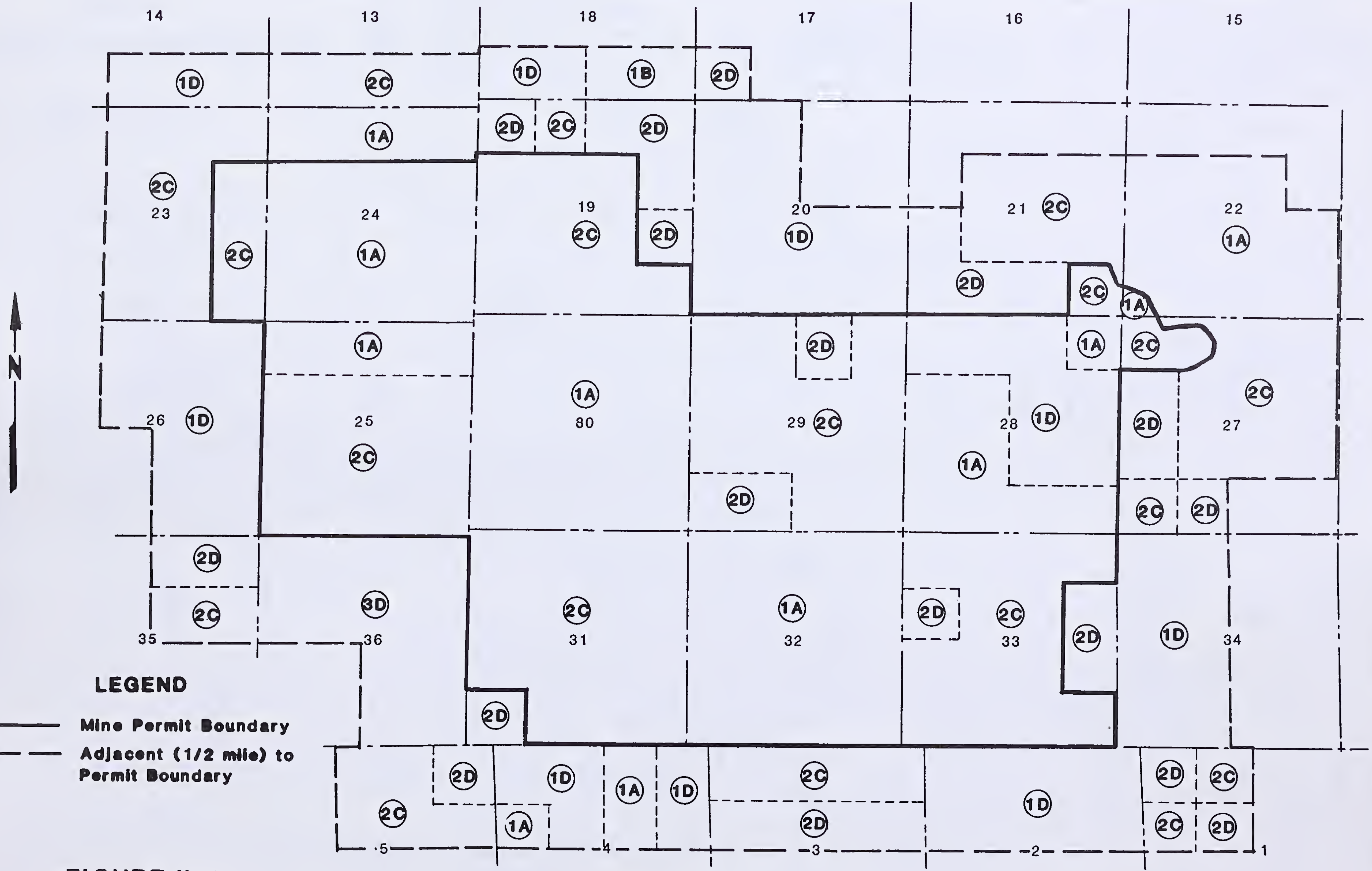
1. James N. & Mary E. Bailey
2. Peabody Coal Company
3. Burlington Northern Railroad
4. Farley's Inc.- Armells
5. Ashenhurst Ranch Inc.
6. State of Montana
7. Western Energy Company
8. Greenleaf Land & Livestock Co.
9. U.S.A.

SURFACE LESSEES

A. Peabody Coal Co. - Lease No. Fed. M-15965

B. Peabody Coal Co. - Lease No. Meridian TM4625

C. Not under lease



LEGEND

Mine Permit Boundary

Adjacent (1/2 mile) to Permit Boundary

FIGURE II-3

Coal Ownership/Coal Lessees for Area B, Big Sky Mine

COAL OWNERSHIP

1 U.S.A.
2 Meridian Minerals Company
3 State of Montana

COAL LESSEES

A Peabody, Fed. Lease No. M-15965
B Western Energy, Fed. Lease No. M-54711
C Peabody Coal Co., Merdian Minerals Lease No. TM4625
D Not under lease

General Project Description

The mine is currently projected to produce and ship an average of 2.8 million tons per year of coal from the sub-bituminous Rosebud seam with a low of 1.9 million tons and a high of 2.9 million tons per year. Peabody would operate as a surface coal mine with a maximum production capacity of 4 million tons per year. Although the mine capacity is 4 million tons per year, the primary analysis is based on the proposed production levels previously stated. The mine would produce approximately 64 million tons of coal over its life. Overburden would be removed with draglines. Coal would be removed with shovels and hauled with 120- to 150-ton bottom-dump trucks. Soil would be handled with scrapers or occasionally with trucks and front-end loaders. Final grading and soil removal and redistribution would be accomplished with bulldozers, scrapers, and graders. Revegetation would follow.

Coal extraction from Area B would begin in 1989, with 1,954,500 tons projected to be removed during that year. The coal would be hauled an average of 4.4 miles to the existing truck-dump hopper in Area A, crushed, and conveyed to the existing 29,000-ton-capacity, covered slot storage facility. The slot storage facility is located adjacent to a railroad loop where the coal would be loaded into 110-car unit trains for shipment to the customer. Some coal may be stored on the ground next to the truck-dump hopper in the event of equipment malfunctions or for blending purposes. The coal quantity, quality, recovery, and other pertinent facts are summarized in table II-1.

Mine Plan

Coal resources of Area B, located in the Lee Coulee drainage basin, extend both north and south, as well as beneath a portion of Lee Coulee. The coal field is the shape of a compressed "C" with the open end oriented to the southeast. Although two coal seams are present in this area, only the Rosebud seam would be mined. This seam is approximately 24 feet thick. The stratigraphically lower McKay seam would not be mined due to the high sulfur content which renders it unmarketable. Although the maximum mining limit would vary depending on overburden depth, topographic features and mine plan layout, the maximum overburden thickness for the recovery of coal is approximately 100 feet.

For descriptive purposes, the Area B Mine Plan is divided into a north and south mining block (figure II-4). These two blocks are generally bisected by Lee Coulee. Mining in the north block would occur for approximately 12.7 years before moving to the south block and continuing for another 10 years.

Table II-1: Big Sky Mine Area B Fact Sheet

Affected Area:

Areas (in Acres)	Year 1	1st Permit Term	Life-of-Mine
Disturbed Area	376.9	924.6	3,200.0
Permit Area			5,435.8

Rosebud Seam:

Quantity		Quality	
Peak Production Rate	= 2,905,100 Tons/Yr.	BTU (dry basis)	= 11,435
Inplace Reserve	= 72,500,200 Tons	Ash	= 13.63
Recovered Reserve	= 63,849,600 Tons	Sulfur	= 1.44
Recovery Percent	= 88.1	Equilibrium Moisture	= 24.6
Average Thickness (ft)	= 23.88		

The first 5 years of mining would begin in the eastern part of the north block in 1989, and progress into the central portion of the north block in 1993. Due to a portion of the coal outcrop extending up Bad Bob Gulch (see Chapter III - Topography and Geomorphology), and the relatively short cut lengths, mining would occur concurrently on both sides of the gulch and progress northward. The cuts would be oriented in a northwest-southeast direction and progress from cropline-to-cropline in the southern portion and from cropline-to-recovery line (economic limit of mining) in the northern portion. Mining then would move into the central portion of the north block along a cropline, developing cuts in an east-west direction and progressing northerly. Overburden depths to 110 feet would be encountered in this block. A thin inseam parting within the coal seam would be present as mining progresses to the east, but it is not anticipated to cause handling problems. A small portion, approximately 1 foot or less, of the top and bottom of the coal seam would not be recovered due to the higher sulfur content. A small area within the central section, Marmot Mound (figure II-4), would not be mined due to overburden depths approaching 300 feet, precluding the economic recovery of the coal beneath. Mining would, however, abut Marmot Mound.

The second 5-year mining block (years 1994 through 1998) would begin in the central part of the north block and progress into the west portion along Lee Coulee. Mining would continue, developing cuts in an east-west

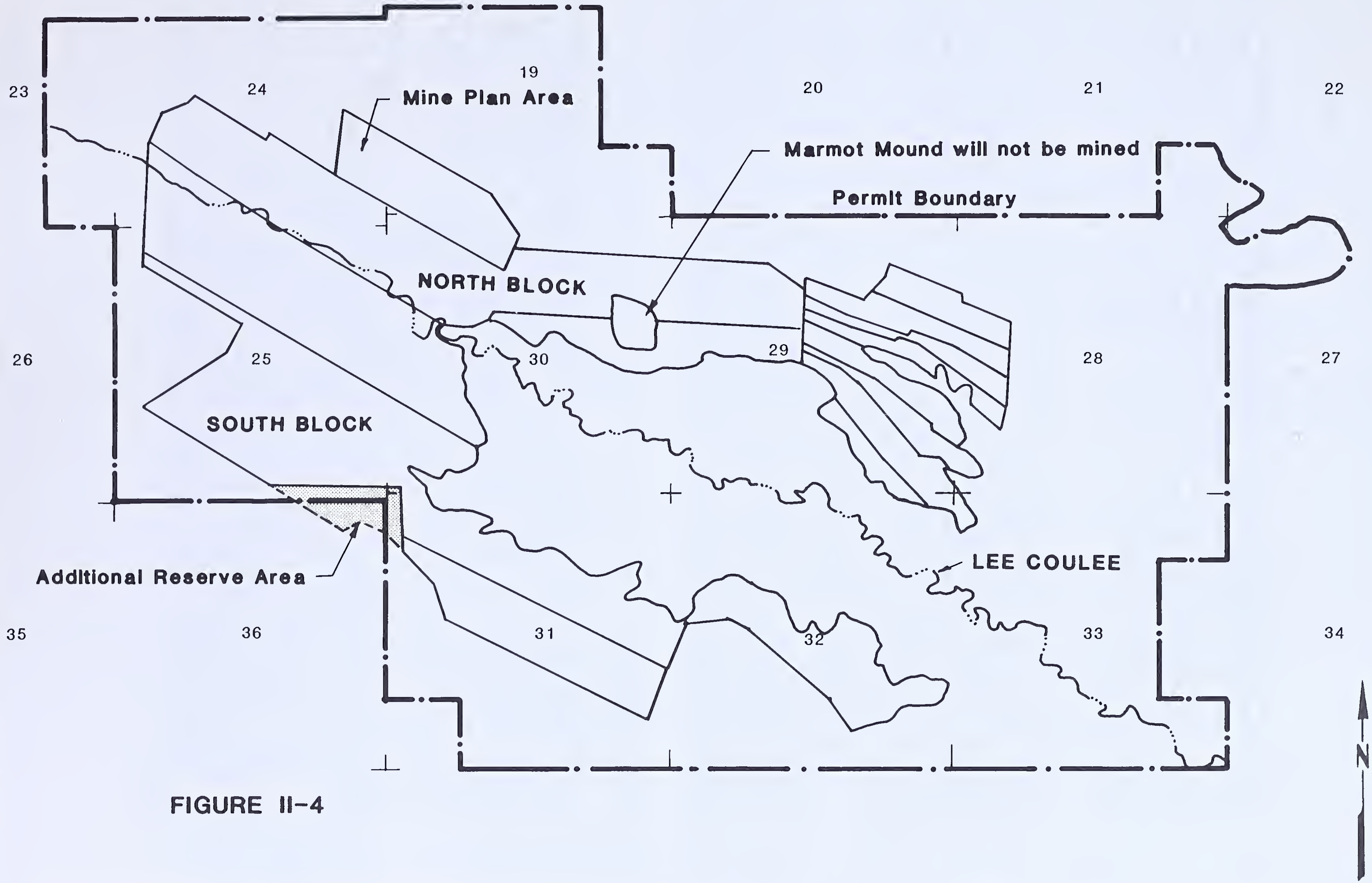


FIGURE II-4

General Resource Area Blocks, Big Sky Mine, Area B

orientation and progressing northerly to a recovery line. Mining would again abut portions of Marmot Mound. Mining would then move to the western portion of the north block to develop a boxcut approximately parallel to Lee Coulee and progressing northeasterly. Coal would be recovered in areas where overburden depths approach 40 feet. The thin inseam parting and top and bottom portions of the seam would not be recovered because of poor coal quality. The cuts developed along Lee Coulee may experience shallow ground water inflow.

Mining in the third 5-year block would continue in the western part of the north block and progress northeasterly to a recovery line during the years 1999 and 2000. Mining would then return to Lee Coulee in the south block, excavating cuts parallel to the former boxcut area in a northwest-southeast direction and progressing southwesterly through year 2003. Coal recovery operations would encounter overburden depths up to approximately 110 feet. The low quality coal in the top and bottom portions of the seam would not be recovered. The cuts in this section may experience some shallow ground water inflows.

The remainder of the south block would be mined during the years 2004 through 2011 in a manner similar to the north block. Mining would develop pits oriented northwest-southeast beginning at a cropline and progressing southwesterly to a recovery line. Overburden depths to 120 feet would be encountered in portions of this block. The thin inseam parting within the Rosebud seam present in the north block is also present in the south block. Portions of the top and bottom of the coal seam would again not be recovered.

Mining Methods

Coal extraction in Area B would be a conventional form of single seam strip mining called area mining, wherein the overburden above the coal is removed in parallel strips across the coal field until the area is completely mined. A dragline would excavate the overburden by creating wide trenches or cuts and deposit the material along the side of the cut. When mining in a coal field begins, the first cut is called a boxcut and the overburden and rock material excavated from the cut is called boxcut spoils. This spoils differs from other spoils in that it is placed outside and adjacent to the cut being mined onto lands that have not been mined. This material would eventually be re-graded to an acceptable postmining configuration. The other spoils, internal spoils, results from cuts created after the initial boxcut and is placed directly into the adjacent, previously mined cut.

The dragline would be the primary excavator of overburden material. Equipment such as trucks and shovels or loaders and scrapers may also be used to assist with overburden or inseam parting removal. When trucks and shovels or scrapers are utilized, excavated material remains in the cut or pit area. A bulldozer is continually assigned to the dragline to perform bench leveling, access road preparation, trailing-cable relocation, and miscellaneous duties.

The overburden excavation process begins with the digging of the narrow slot, or key cut, down to the coal seam to establish the highwall. The location of the key cut and the spoils establishes the width of the pit. The dragline positions itself above the area to be excavated and in line with the direction the cut is progressing. The dragline bucket is lowered to the material to be excavated, drawn toward the dragline, lifted, and swung to the side, at which point it dumps or spoils the excavated material into a previously mined cut or along the side of the cut onto unmined ground. This process is repeated until the entire area in front of the dragline has been excavated.

The dragline then is repositioned and begins another key cut and starts the process again. This procedure is followed until the operational limits of the machine are achieved or pit boundaries are reached. At this point, the dragline walks, or deadheads, to where the next cut is to begin. The entire process starts again with each successive cut being excavated parallel to the previously mined cut and continues until excavation activities are complete within the pit. Cut widths vary depending upon coal field characteristics and mine plan layout, but typically average approximately 105 feet. Highwall angles should be approximately 62 degrees from horizontal.

The inseam parting in the middle of the Rosebud seam varies in thickness to almost 2 feet. Parting removal would be accomplished primarily with bulldozers and sometimes scrapers. Bulldozers would rip the parting, then push it off the coal seam to be removed. If it becomes necessary to move the parting material to another location within the immediate pit, scrapers may be utilized.

Once the overburden or parting has been removed from the coal seam, any remaining non-coal material would be cleaned from the top of the coal seam utilizing rubber-tired or track-type dozers. The coal seam would then be drilled and blasted using the same procedures used to fragment overburden. Electric shovels would be primarily used to load the coal into trucks for transportation to coal handling facilities. Rubber-tired, front-end loaders would be used to load coal in areas where mobility of the loader is required. A generalized diagram of a strip mining operation is included as figure II-5.

Haul Road

Access to Area B would be gained via a 4.3-mile haul road. This road would consist of 3.7 miles of new construction within the proposed Area B permit boundary and 0.6 miles of existing road previously permitted in Area A located in N1/2 N1/2 of Section 27, T1N, R41E. Reclamation work has been completed on both sides of this 0.6-mile section of haul road. The remainder of the haul road alignment would traverse some previously reclaimed portions of Area A before continuing on to Area B. All suitable soil would be salvaged, stockpiled, seeded, and protected from contamination for future reclamation of the road alignment at the end of the mining operation.

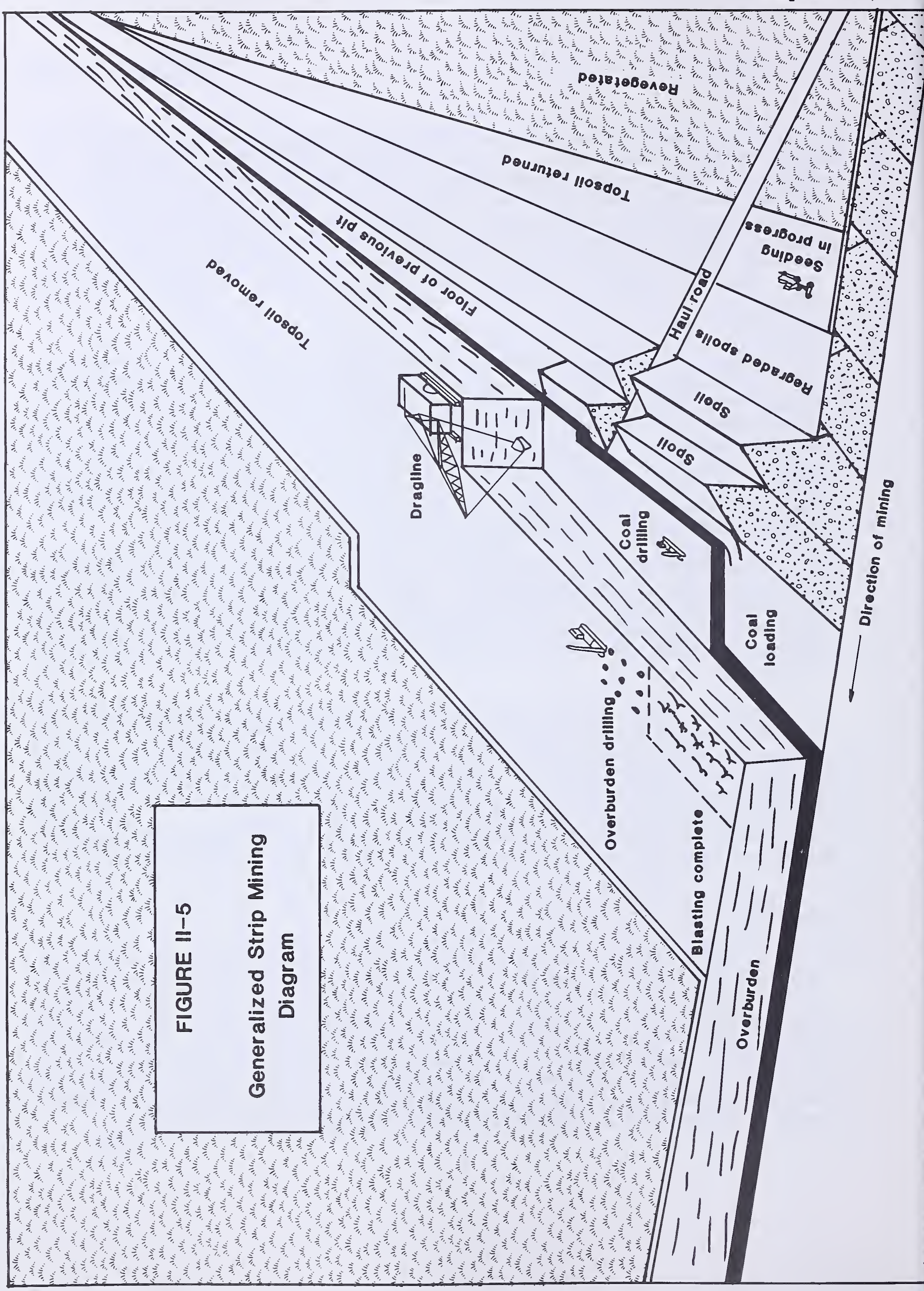


FIGURE II-5

Generalized Strip Mining Diagram

New road construction would begin immediately upon approval, and would serve as an access route and haul road to Area B as well as the deadhead route for the dragline. Off-highway haul trucks (120- to 150-ton capacity) would transport coal from Area B to the existing loading facilities presently serving the Area A mining operation.

Office and Maintenance Facilities

Maintenance and office facilities for Area B would be established on a site located in the SW1/4 of Section 29, T1N, R41E.

Approximately 350,000 cubic yards of clinker overlay the McKay coal seam in the facilities area. Backfilling and grading of this material would provide the foundation for the facilities site, with excess clinker material from overburden removal to be used in surfacing of the haul road system.

A maintenance building (approximately 20 feet by 40 feet) would be constructed initially on the prepared site, and an office trailer (approximately 12 feet by 40 feet) would be placed on site at the same time.

Existing Support Facilities

The proposed Area B mining operation would utilize a number of existing facilities which currently support the Area A operations. The following is a list of these facilities:

--Main Office Building

--Maintenance Shop and Warehouse

--Equipment Storage Area

--Miner's Change Area

--Telephone Communications System

--Coal Handling and Loading Facilities

--Access Road

--Railroad Spur and Loop Track

Coal Handling Facilities

The present coal handling facilities at Area A would continue to be utilized for Area B. These facilities consist of a tipple, conveyor system, and a covered slot storage.

The tipple is a combination dump hopper and primary/secondary crusher. This facility is capable of producing 1,900 tons of sized coal per hour.

The slot storage facility has concrete walls, a concrete floor and is covered by a metal roof. This facility, which has a storage capacity of 29,000 tons, protects the coal and minimizes fugitive dust.

Hydrologic Considerations

During the life of the proposed Area B Mine, 21 sediment ponds would be constructed to impound the runoff from disturbed areas and provide sufficient detention time for the 10-year, 24-hour runoff event before any water is discharged from the ponds. Not all of the 21 sediment ponds would be constructed initially (table II-2). Nine ponds would be built by 1994, with capacities ranging from 6 to 34 acre-feet and a total capacity of 125.6 acre-feet. The ponds would be constructed on most of the side tributaries and on the upper mainstem of Lee Coulee within the proposed permit boundary. Peabody would implement sediment pond dewatering as needed (regulations require cleanout when ponds are 60 percent full of sediment) to maintain storm water runoff capacities. Typically, dewatering would take place after flows or pumped water into sediment ponds have subsided and the entrained sediment has settled out. Peabody would apply for and obtain a DHES permit applicable to discharge structures in Area B.

Diversions and culverts would be employed to transmit surface runoff within and around the disturbed areas. Four temporary diversions would be constructed to prevent additional surface water runoff from entering disturbed areas and to convey runoff to sediment ponds. All diversions are designed to handle the runoff from a 10-year, 24-hour runoff event. Culverts have also been designed to pass the 10-year, 24-hour, and in some cases, the 25-year, 24-hour event. Culvert outlets to the sediment ponds would be riprapped to reduce the potential for erosion below the outfalls. In addition, periodic inspections would be conducted at the other culvert sites to ensure that accelerated erosion at the outfalls does not go unchecked.

Six wells, five ponds, and one spring used for watering livestock have been identified within the proposed Area B permit boundary. Of the 12 water sources identified, three wells and three ponds would be removed by mining. These water sources are all owned by Peabody. Peabody would replace some water sources which are degraded or dewatered to the point where the pre-mining water use is no longer possible. Peabody may abandon those water sources for which they hold water rights.

Reclamation

Peabody proposes a number of measures to restore Area B to a productive state. Reclamation would concentrate on returning the area to the historic land uses of native rangeland for livestock grazing and wildlife habitat. Livestock grazing may be enhanced by seeding a mix of palatable grasses,

Table II-2: Sediment Pond Construction, Reclamation Schedule, and Storage Capacities

Pond	Completion Years	Reclamation Year	Design Storage Capacity (acre/feet)[1]
B1	1989	1998	17.62
B2	1989	2024	19.67
B3	1989	2024	19.60
B4	1989	2003	15.25
B5	1989	2003	6.15
B6	1989	2005	3.82
B7	1989	2018	10.78
B8	1993	2018	14.54
B9	1993	2018	18.60
B10	1996	2018	20.00
B11	1996	2018	10.00
B12	1996	2018	65.00
B13	1996	2018	34.00
B14	2003	2023	22.00
B15	2003	2023	26.00
B16	2003	2023	19.90
B17	2008	2024	10.00
B18	2008	2024	19.00
B19	2009	2024	6.00
B20	2010	2024	10.00
B21	2011	2024	21.00

Source: Peabody Coal Company 1987a.

[1]Both sediment and water capacity. These are minimum storage capacities. Final storage capacities will be determined when designs are completed.

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forbs, and shrubs with higher overall forage production and by better distribution of water. Areas of concentrated shrub and tree plantings would be established to promote habitat diversity. Sixteen bluff extensions (partially retained highwalls extending existing bluffs) are proposed for the northern and southern limits of the mine disturbance area. North-facing slopes of approximately 3:1 are planned for reestablishment of a small acreage of the ponderosa pine communities and wildlife habitat.

Backfilling and Grading

Rough grading would be performed with bulldozers, scrapers, graders, and draglines. Bulldozers and scrapers would be used for final grading. Typically, the process of grading begins with bulldozers building roadways into the ungraded spoils. Once sufficient access into the spoils is provided, dozers or scrapers move and deposit the spoils material to achieve the desired land form. The movement of spoils material is generally downslope, due to economic and safety considerations. Rough backfilling and grading would be completed within 180 days following coal removal. Backfilled materials would be placed to minimize adverse effects on ground water, minimize off-site effects, and to support the approved postmining land use. Prior to applying soil, the spoils would be ripped to a depth of 12 to 24 inches.

Soil Handling

Before any area at the mine site other than a proposed soil stockpile site would be disturbed, the suitable soil material would be removed to the specified depth. Suitable soil would be salvaged from all disturbance areas including sediment ponds, haul roads, clinker pit, access road, mining area (includes the boxcut spoils and highwall reduction areas), and diversion ditches. Soil would be removed from all cut-and-fill slopes. First-lift soil would also be removed from the designated second-lift subsoil stockpile sites. No soil would be salvaged from the light-use roads utilized for environmental monitoring or powerline corridors, except where cut and fills are required. Prior to soil removal, vegetation too large for incorporation into the soil would be removed and combined with the overburden. The remaining vegetation would be incorporated into the soil to help increase soil organic matter. To prevent unnecessary soil contamination, the soil would be salvaged a minimum of 10 to 15 feet from the edge of a road, embankment, ditch, cut slope, or toe of fill.

Soil would be removed by using self-loading scrapers, push scrapers, or other rubber-tired equipment. A dozer or road grader would also be used when needed to assist scraper loading, to facilitate maximum soil recovery, and to help build and shape soil stockpiles. Where soil exists on a steep slope and where there is enough room for scrapers to maneuver at the bottom of that slope, soil would be removed with a dozer, picked up with scrapers, then stockpiled or transferred directly to regraded areas (direct haul). A two-lift soil removal operation would be utilized for all soil types with a salvage depth greater than 0.5 feet, whereby the "A" and upper "B" horizons are salvaged separately from the lower "B" and "C" soil horizons.

When direct haul of soil is not feasible, soil would be stored in approved stockpiles. Stockpiling of soil would be required for soil removal in the initial boxcut, haul road, sediment ponds, facilities, and final pit and highwall reduction areas. Soil stockpiles would be located in areas where they would not be disturbed by the ongoing mining operation and where the stored soil would not be lost to wind erosion or surface runoff.

Soil replacement would occur when the approved postmine contours are achieved and no additional disturbance is anticipated. Soil would be replaced along the contour, except where limited by steep slopes, to minimize potential erosion and soil/spoils interface slippage.

Revegetation

Revegetation of disturbed areas would commence after completion of backfilling, grading, and replacement of soil. Establishment of vegetation would aid in erosion control and restore productivity of the land. Revegetation methods have been designed to establish a diverse, permanent vegetative cover with characteristics similar to existing plant communities.

Prior to respreading soil, final graded spoils would be deep-ripped to a depth of approximately 12 to 24 inches. Ripping would reduce compaction in the graded spoils resulting in increased infiltration and percolation of water before and after soil replacement. After soil replacement, the areas would again be ripped on the contour. The reconditioning of graded spoils and replaced soil as described above would be carried out in all reclaimed areas unless the steepness of slopes limits safe equipment operation.

Mulching would be carried out on an as-needed basis as determined by the applicant or DSL. Areas that may be mulched would include reclaimed drainages and areas with slopes greater than 5:1. A manure spreader would be used to spread straw on reclaimed areas. Clean grain straw would be applied at the approximate rate of 3,000 pounds per acre. Anchoring and partial incorporation of the mulch would be done with a reclamation tractor and chisel plow attachment.

Peabody has proposed six separate seed mixes plus a supplemental shrub and forb seed list and a shrub and tree seedling list (see Appendix). A temporary cover crop of annual grains (winter wheat or barley) would be seeded in all areas permanently reclaimed and on an as-needed basis for temporarily reclaimed areas. The appropriate seed mixes including supplemental species would be either broadcast or drill seeded into the temporary cover crop.

Bonding

Peabody must submit a reclamation performance bond to DSL and OSMRE. The amount of the bond is based on the maximum or worst case reclamation liability which would be encountered during the initial review period. The bond is presently estimated to be $3,514,713.00. Upon successful reclamation, the bond would be returned to Peabody.

Mine Employment

No new employees would be added to Peabody's existing work force of 113 as a result of Area B operations.

Environmental Monitoring

Peabody's operation would incorporate a number of ongoing environmental monitoring programs. These programs would monitor surface water (flow and quality), ground water (depth and quality), vegetation (species composition and ground cover), regraded spoils quality, air quality, and wildlife.

THE ALTERNATIVES

Four alternatives, including the applicant's proposal, are discussed in, this EIS. Alternative 1 considers Peabody's proposal as submitted in its application for a surface mining permit. Alternative 2 considers Peabody's proposal, but includes mitigating measures that would reduce environmental impacts. Alternative 3 considers modifications of the mitigated mine plan analyzed under Alternative 2 to mine a portion of Section 36. Alternative 4 considers denial of the proposal. The consequences of each alternative are analyzed in Chapter IV. This chapter describes each alternative.

Alternative 1: Approval of the Applicant's Proposal

This alternative (Peabody's mining plan as proposed) does not meet the minimum requirements of SMCRA and SUMRA, therefore: the DSL Commissioner would not approve the mining plan as proposed; the Division Chief in OSMRE's Western Field Operations would not approve the Federal permit to mine coal; and the Secretary would not approve the applicant's proposal life-of-mine mining plan. This alternative is presented only for comparative purposes in the environmental analysis.

Alternative 2: Approval of the Applicant's Proposal, with Conditions

Under this alternative, the DSL Commissioner would approve the applicant's proposed State permit to mine coal; the Division Chief in OSMRE's Western Field Operations would approve the applicant's proposed Federal permit to mine coal; and the Secretary would approve the applicant's proposed life-of-mine mining plan; subject to conditions necessary to bring the proposal into compliance with the minimum requirements of SMCRA, SUMRA, and all other applicable Federal and State laws, such as the Mineral Leasing Act of 1920, the Federal Land Policy and Management Act, the Endangered Species Act, the National Historic Preservation Act, the Clean Air Act, and the Federal Water Pollution Control Act, as amended (i.e., the Clean Water Act). The additional conditions would be:

Condition A

Peabody would replace water sources lost due to mining. The replacement sources would provide water for livestock, wildlife, and habitat for aquatic species. Replacement wells for livestock would be adequate to support premining levels of use. Each well removed by mining would be replaced.

Water sources would be adequate to provide appropriate seasonal needs for wildlife. Stock tanks would be less than 20 inches high. Floating platforms and escape ramps would be placed in stock tanks to avoid entrapment of small animals. Overflow ponds would be protected from livestock while allowing wildlife to use the areas.

Quality of replacement water would be as close as practicable to premining water quality. TDS concentrations would not exceed 5,000 parts per million (ppm) and sulfate concentrations would not exceed 2,500 ppm in flowing water.

Peabody would not remove Gumdrop Spring. The new permanent impoundment constructed below Gumdrop Spring would be located so that water levels would not increase behind the impoundment and inundate the spring.

Condition B

Alluvium would be selectively handled and replaced in reconstructed stream channels to facilitate regrowth of riparian vegetation following reclamation. Peabody would submit detailed plans to DSL and OSMRE specifying how they would salvage and replace alluvium.

Condition C

Because of textural and chemical properties of shale rock outcrops, Peabody would:

--Define the areal extent of problem soils and overburden.

--Selectively place problem soils and overburden in spoils to avoid surface and ground water contamination and impacts on plant growth.

Condition D

Peabody would selectively handle, stockpile, and replace in restored drainageways the existing alluvial soils to ensure a good growth medium for riparian plants. Peabody would submit detailed plans to DSL and OSMRE specifying how they would salvage and replace the alluvial soils in drainageways.

Condition E

Peabody would develop mitigation plans for seven sites eligible for listing in the National Register of Historic Places. The sites would include: 24RB1145, 24RB1150, 24RB1153, 24RB1164, 24RB1171, 24RB1181, and 24RB1185. These sites would be protected from disturbance until required mitigation measures were implemented. All mitigation plans would be subject to approval of DSL, OSMRE, and SHPO.

Condition F

A photographic survey and study of the buffer zone, where access has been denied by landowners, would be completed by Peabody to determine whether cultural or historical structures exist that could be affected by mine blasting. Information from the survey and study would be submitted to DSL and OSMRE for review and approval prior to the start of mining. Necessary protection measures would then be developed by DSL, OSMRE, and SHPO prior to disturbance by mining associated activities.

Condition G

Additional field testing of cultural resources would be done at site 24RB1163 and Loci L20 and L25. A report documenting the results of the field testing would be prepared by Peabody and reviewed by DSL, OSMRE, and SHPO. If the report indicates the site or loci are eligible for listing in the National Register of Historic Places, a mitigation plan would be prepared and approved by January 1, 1990. Mitigation would be complete by 1994.

Condition H

Peabody would reestablish ponderosa pine vegetation to an area approximately equal to that destroyed by mining. Additional acreage required for ponderosa pine reestablishment would come from the needle-and-thread grassland type.

Condition I

Peabody would submit and obtain approval of a detailed raptor mitigation plan and implement the plan before mining comes within 1/2 mile of an active golden eagle nest or 1/4 mile of an active prairie falcon nest. The plan would specify measures to minimize disturbances to nesting raptors, artificial nest site locations, and construction techniques. Snags and nest boxes would be placed on reclaimed lands.

Condition J

The proposed disturbance area would be searched for the rare, small-flowered evening primrose (Camissonia minor). If this species is found in the haul road route, the route would be adjusted to miss the plant. If the route adjustment is not possible and the plant occurs on the route or in the pit site, the plants would be transplanted to suitable undisturbed habitat and ripe seeds would be saved and planted.

Alternative 3 (Preferred Alternative): Approval of the Applicant's Proposal with Conditions, and the Addition of Economic Coal Reserves in Section 36

Under this alternative, the DSL Commissioner would approve the applicant's proposed State permit to mine coal; the Division Chief in OSMRE's Western Field Operations would approve the applicant's proposed Federal permit to mine coal; and the Secretary would approve the applicant's proposed life-of-mine mining plan; including an additional acreage of economical coal reserves in the extreme northeastern corner of Section 36, T1N, R40E; subject to conditions (listed under Alternative 2) necessary to bring the expanded proposal into compliance with the minimum requirements of SMCRA, SUMRA, and all other applicable Federal and State laws.

This alternative would involve a change in the mine plan in the south-western corner of the proposed permit area to incorporate mining of economic coal reserves, owned by the State of Montana, in the extreme northeastern corner of Section 36, T1N, R40E. Peabody has applied to the State for this lease and the application is pending. This area would be logically included in the mine plan for the last portion of the south block (years 2005 to 2012). The total amount of affected coal in Section 36 is 541,200 tons. This mine plan change would also allow the recovery of an additional 793,700 tons of leased coal adjacent to Section 36, for a total additional coal recovery of 1,334,900 tons. This represents about 5 to 6 additional months of mining at the proposed rate. The total permit area and disturbance area would be increased by about 40 acres.

The coal conservation directives of the regulations require the State to maximize the recovery of economically minable coal within logical mining units. The inclusion of Section 36 would avoid leaving a small area of coal which might become economically unminable.

Alternative 4: Disapproval of the Applicant's Proposal

Under this alternative, the DSL Commissioner would disapprove the applicant's proposed State permit to mine coal; the Division Chief in OSMRE's Western Field Operations would disapprove the applicant's proposed Federal permit to mine coal; and the Secretary would disapprove the applicant's proposed life-of-mine mining plan; because they did not meet the requirements of the Mineral Leasing Act of 1920, SUMRA, SMCRA, or other applicable Federal

and State laws; or because the proposal either imposed or had the potential to impose unacceptable impacts on the human environment.

OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Other potential project options and alternatives were also considered. These options did not provide environmental advantages or were economically or technically unfeasible. These other options are briefly described as follows, but are not analyzed further in this document.

Mining of the McKay Seam: The McKay coal seam is located below the Rosebud seam with an average interburden thickness of about 29 feet. Peabody currently mines both seams in Area A, but proposes to mine only the Rosebud seam in Area B. Peabody's customer does not want McKay coal because of its higher sulfur content and the resulting air quality concerns with respect to sulfur dioxide. The McKay seam averages 2.15 percent sulfur and the Rosebud seam 1.44 percent sulfur. Peabody and its customer investigated various marketing, blending, and emission control technology scenarios, but were unable to arrive at a viable solution. Based on these facts, the McKay seam is considered unmarketable at this time.

Use of a Coal Conveyor: It would be possible to transport coal from Area B to the Area A facilities and loadout using an overland conveyor system rather than the proposed haul truck system. The environmental benefits of this would be to potentially reduce the amount of disturbance along the connecting corridor and to reduce the amount of particulate air pollutants emitted. Given the mitigation measures proposed and stipulated for the project, the environmental benefits of a conveyor system are considered minimal and economic considerations favor hauling.

The No Action Alternative

The no action alternative was evaluated and determined not to be reasonable for the decisions on the applicant's State and Federal permits and life-of-mine mining plan. Peabody has fulfilled the requirement of its leases and has filed a complete permit application package with DSL and OSMRE. Therefore, decisions on whether to approve the proposed State and Federal permits and life-of-mine mining plan are required by law.

However, for DSL and OSMRE, the impacts to the human environment of implementing the no action alternative would be the same as those of disapproving the proposal (Alternative 4). Thus, for the purpose of this EIS, these alternatives are considered to be equivalent.

CHAPTER III:

THE EXISTING ENVIRONMENT

CLIMATE

The Colstrip area is characterized by a semi-arid continental steppe climate with large temperature extremes. The area is influenced by descending air masses and clear skies with a high frequency of temperature inversions during the winter months. The majority of large-scale weather systems move from west to east through the area. Surface humidity is generally low.

The mean annual precipitation is 15.52 inches at the Colstrip National Weather Service station (National Oceanic and Atmospheric Administration 1987). About 70 percent of the precipitation falls during the growing season, April through September. The greatest monthly amounts usually fall in May and June. Thunderstorm activity is common during the spring and summer with occasional hail during mid-summer. Rains are also frequent in late spring and early summer.

Winter precipitation is generally light, amounting to just over half an inch per month from November through February, usually in the form of snow. Measurable snowfall can be expected as early as September and as late as May.

Annual potential evapotranspiration (PET) is approximately 31.3 inches (Peabody Coal Company 1987b), thus PET exceeds precipitation. Reservoir evaporation ranges from 33 to 53.6 inches per year in southeastern Montana (Goering and Dollhopf 1980, Peabody Coal Company 1987b).

The mean annual temperature at Colstrip is 46.2 degrees F. The average temperatures during the warmest month (July) and the coldest month (January) are 71.8 degrees F and 20.0 degrees F, respectively (National Oceanic and Atmospheric Administration 1987). Maximum temperatures of above 90 degrees F occur frequently in July and August. Summers are characterized by warm days and cool nights.

Spring and fall are cool with few days exceeding 90 degrees F from October through April. Periods of several days with below-zero temperatures can be expected during the winter months. Zero readings have been recorded as late as April 1 and as early as October 28. Killing freezes do not generally occur after the last week in April or earlier than the first week of October. The growing season averages about 158 days.

Peabody has performed meteorological monitoring at the Big Sky Area A Mine since 1974. The monitoring location is at the Area A Mine Shop Office. The predominant wind direction is from the west. For calendar year 1985 (used as a representative year), 14.0 percent of wind direction occurrences were westerly, and the 135-degree sector from south-southwest through north-northwest accounted for 61.7 percent of total wind direction occurrences. The average wind speed for 1985 was 7.6 miles per hour. The maximum wind speed recorded was 46 miles per hour on October 23. Approximately 7.4 percent of the winds recorded were calm, while less than 1 percent exceeded 31.5 miles per hour (Peabody Coal Company 1986b).

Peabody also has operated a meteorological station in Area B since 1983. This site is at the Area B baseline air quality monitoring station described in the following section. The meteorological data from this site for three calendar years (1984, 1985, and 1986) was used to derive a joint frequency table of wind speed by wind direction by stability class. This data was then used as the input for the air quality dispersion modeling analysis discussed in the air quality section of Chapter IV. A detailed description of the data and the computer model is included in the air quality permit application. A copy of the air quality permit application is included in the permit application package submitted to DSL and OSMRE.

AIR QUALITY

Current sources of air pollution in the Colstrip area include coal surface mining with related activities (Peabody Coal Company and Western Energy Company), Colstrip Generating Units 1, 2, 3, and 4 (coal-fired power generating facilities), agricultural activities, and vehicle-related emissions. These sources include both gaseous and particulate emissions. Gaseous pollutant concentrations in proposed Area B are assumed to be quite low, and since the primary concern with the proposed mining operation is particulate emissions, the following discussion pertains mainly to particulate levels.

Peabody has monitored total suspended particulate (TSP) near Area B since October, 1984. This monitoring site is located at the extreme upper end of Lee Coulee in Section 23, T1N, R40E. TSP data for approximately 17 months through March, 1986, is presented in the air quality permit application. The annual average TSP concentration was 12.9 micrograms per cubic meter (ug/m^3) and the maximum 24-hour concentration was 57 ug/m^3 (Peabody Coal Company 1987b). These results are similar to background levels for the region and indicate that the area is minimally affected by air pollution at this time.

Peabody has also monitored TSP around its existing Area A operation for the last 13 years. The Substation Site, No. 2, located west of the current mining operations, recorded an annual arithmetic mean of 27.6 ug/m^3 in 1987. This site is generally upwind of mining activities. Two sites located close to active operations and downwind recorded higher levels. The Tipple Site,

No. 5, and the Coulee Site, No. 6, had TSP levels (arithmetic means) of 104.4 ug/m^3 and 89.3 ug/m^3, respectively. These values exceeded the Montana ambient air quality standard applicable at the time. The Tipple Site is located within the existing Area A permit boundary immediately east of the coal crushing, storage, and loadout facilities. The Coulee Site is located approximately 2,000 feet northeast of the Tipple Site and 1.1 miles west of the nearest public road, Highway 39. The Powder Magazine Site, No. 4, recorded 30.2 ug/m^3 (Peabody Coal Company 1988). This site is also located downwind, but at a distance of about three-quarters of a mile from the existing operation. The lower levels at this site are indicative of fugitive dust impacts related to mining. Higher particulate readings typically occur near the source, but due to settling of the large particles, levels drop quickly as distance from the source increases. In general, air quality impacts from mining are localized.

Western Energy Company and The Montana Power Company also operate monitoring networks in the Colstrip vicinity. Data from this monitoring indicate the same pattern as previously discussed. Samplers located near active operations have higher readings, while those located at greater distances are close to background levels (Western Energy Company 1988). The town of Colstrip also has elevated particulate levels, probably caused by vehicle traffic and to a lesser extent by mining activities.

The basis of the Federal and State ambient particulate standards has recently changed from TSP to particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM-10). This change in standards was made because of the greater health risk associated with smaller diameter particles. Table III-1 lists the various Federal and State ambient air quality standards. The old (repealed) TSP standards are included for comparison with the TSP data discussed in this document.

An area of 120 square miles centered at Colstrip is currently designated as being in nonattainment of the Federal secondary TSP standard. The southern boundary of the nonattainment area passes through proposed Area B. Based on the repeal of the Federal TSP standards, the Montana Air Quality Bureau has petitioned EPA to remove the nonattainment designation. The original designation was based on monitoring data in and very near Colstrip, but particulate levels in outlying areas, such as proposed Area B, have been found to be well below the applicable ambient standards. For this reason, the size of the nonattainment area was not representative of actual air quality conditions.

GEOLOGY

Topography and Geomorphology

The proposed permit area is located in the Lee Coulee drainage, an ephemeral tributary of Rosebud Creek. Lee Coulee has a branched drainage pattern and flows to the southeast where it joins Rosebud Creek. The wide, relatively flat valley floor of Lee Coulee slopes gently upward to the north

Table III-1: Montana and National Air Quality Standards

Pollutant	Montana Standard	Federal Primary Standard	Federal Secondary Standard
Total suspended particulates (Repealed) (1)	75 ug/m^3 annual average 200 ug/m^3 24-hr average (2)	75 ug/m^3 annual geometric mean 260 ug/m^3 24-hr average (2)	60 ug/m^3 annual geometric mean 150 ug/m^3 24-hr average (2)
Particulate matter less than 10 microns (PM-10)	50 ug/m^3 annual average (3) 150 ug/m^3 24-hr average (3)	50 ug/m^3 annual average (3) 150 ug/m^3 24-hr average (3)	None None
Sulfur dioxide (4)	0.02 ppm annual average 0.10 ppm 24-hr average (2) 0.50 ppm 1-hr average (5)	0.03 ppm annual average 0.14 ppm 24-hr average (2)	0.5 ppm 3-hr average (2)
Carbon monoxide	9 ppm 8-hr average (2) 23 ppm hourly average (2)	9 ppm 8-hr average (2) 35 ppm 1-hr average (2)	9 ppm 8-hr average (2)
Nitrogen dioxide	0.05 ppm annual average 0.30 ppm 1-hr average (2)	0.05 ppm annual average	0.05 ppm annual average
Photochemical oxidants (ozone)	0.10 hourly average (2)	0.12 ppm 1-hr average (2)	0.12 ppm 1-hr average (2)
Lead	1.5 ug/m^3 90-day average	1.5 ug/m^3 calendar quarter average	None
Settled particulate (dustfall)	10 mg/m^2 30-day average	None	None

Source: Montana Department of Health and Environmental Sciences, Air Quality Bureau.

[1]These standards have been repealed, but are included here for informational purposes.
[2]Not to be exceeded more than once per year.
ug/m^3 micrograms pollutant per cubic meter of sampled air.
ppm parts pollutant per million parts of sampled air.
[3]Statistical standard based on 3-year period.
[4]Some special provisions apply to the Billings area.
[5]Not to be exceeded more than 18 times per year.

until intersecting steeper footslopes at the base of rough sandstone cliffs. These sandstone cliffs border gently rolling and level ridgetops. To the south, the valley floor slopes up to meet sandstone cliffs or sparsely vegetated badlands. Total topographic relief in the proposed permit area is about 540 feet.

Within the proposed permit area, four tributaries drain into Lee Coulee from the north and five from the south (figure III-1). Fossil Fork, the largest of these tributaries, drains into Lee Coulee from the south. No accurate measured rates of erosion or sediment yield are available for Area B. Estimated sediment yields are similar, but slightly lower, than those for the Fort Union Formation of the upper Cheyenne Basin in Wyoming (Peabody Coal Company 1986a). A large and rapidly moving headcut near a small reservoir at the Lower Dike (see figure III-1) is one of two areas in the coulee where past stream channel alterations have caused accelerated erosion. The second area where headcuts occur is the western boundary of the proposed permit area along the north fork of Lee Coulee. Much of the intervening portion of Lee Coulee has a stable, well-vegetated channel. Spring storms in 1986 caused some overland flow through a cultivated field below an old spreader dike resulting in erosion through the field. This field is outside the disturbance area.

Other erosional processes in the permit area include rain splash, sheet wash, and rill erosion. These forms of erosion occur in the sparsely vegetated clay badlands in the southern portion of the permit area and along steep, access roads into the permit area. Colluvium at the bottom of steep slopes and cliffs is the only evidence of mass wasting in the proposed permit area. There are no areas of frequent flooding nor areas of unstable geology in the proposed disturbance areas.

Structure and Stratigraphy

Lee Coulee lies within the northern portion of the Powder River Basin. A northwest-southeast anticline is centered on the channel of Lee Coulee and slopes steeply to the southeast. Dips are generally 1 degree or less (Dobbin 1929, Van Voast et al. 1977). Geological faults may occur within the study area, but offsets are generally small (Peabody Coal Company 1987a).

The entire permit area is underlain by the Tongue River member of the Fort Union Formation. The Tongue River member contains a variety of sandstone, siltstone, shale, claystone, and coal seams. The coal seam to be mined, the Rosebud, is shown in the stratigraphic section (figure III-2). A lower quality coal seam, the McKay, would not be mined. The Rosebud and McKay coals do not occur together throughout the permit area. In the lower portion of Lee Coulee, below the area to be mined, a portion of the coal seams has been removed by erosion and burning. The burning of coal has created reddish-colored clinker in the lower portion of Lee Coulee. Clinker is also seen on the ridgetops in parts of the proposed permit area, suggesting that an upper coal seam has burned.

Coal Resources

Only the Rosebud coal seam would be mined under the current proposal for Area B. The Rosebud coal seam varies from 23 to 26 feet thick. The underlying McKay is between 7.4 and 9.5 feet thick in Area B. Assuming an average coal seam thickness of 23.88 feet for the Rosebud, there are approximately 72.5 million tons of coal below the proposed disturbance area. Because it is uneconomical to mine areas with more than approximately 100 feet of overburden present, not all of the coal in the permit area would be mined. Coal below Marmot Mound would not be mined. Total coal produced during the 22.7 years of mining would be approximately 64 million tons.

Overburden

The overburden contains clinker, alluvium with interbedded sandstone, siltstone, and shale of the upper Tongue River member of the Fort Union Formation. Overburden north of Lee Coulee contains more sandstone than overburden to the south where shale and siltstone are more common. The strata in the overburden are not continuous throughout the area, but are lenticular deposits of fluvial origin. Thickness of the overburden ranges from less than 10 feet near the coal cropline to nearly 300 feet.

Interburden

The interburden consists of sandstone, siltstone, and shale with more sandstone in the northwestern part of the permit area. The thickness of the interburden varies from 12 to 75 feet.

The physical and chemical properties of overburden, interburden, and underburden are summarized in table III-2. Substrate type greatly influences the physical and chemical characteristics of the overburden and interburden.

HYDROLOGY

Surface Water

As shown in figure III-1, Lee Coulee flows through Area B and into Rosebud Creek from the west. Fossil Fork, the other major drainage in Area B, is a tributary of Lee Coulee. No perennial streams occur within Area B. Limited data indicate Lee Coulee is an ephemeral stream with intermittent reaches. Ponds 1, 2, 3, and 4 (figure III-1) contain water much of the year (Peabody Coal Company 1987a) and are fed by both surface and ground water flows. The drainage area of Lee Coulee above its confluence with Rosebud Creek is 20.6 square miles. Eventually, 3,238 acres or about 25 percent of the Lee Coulee drainage could be disturbed by mining activities from the existing Rosebud Area B and proposed Peabody mines. The proposed Peabody mine would disturb 3,064 acres in the Lee Coulee drainage.

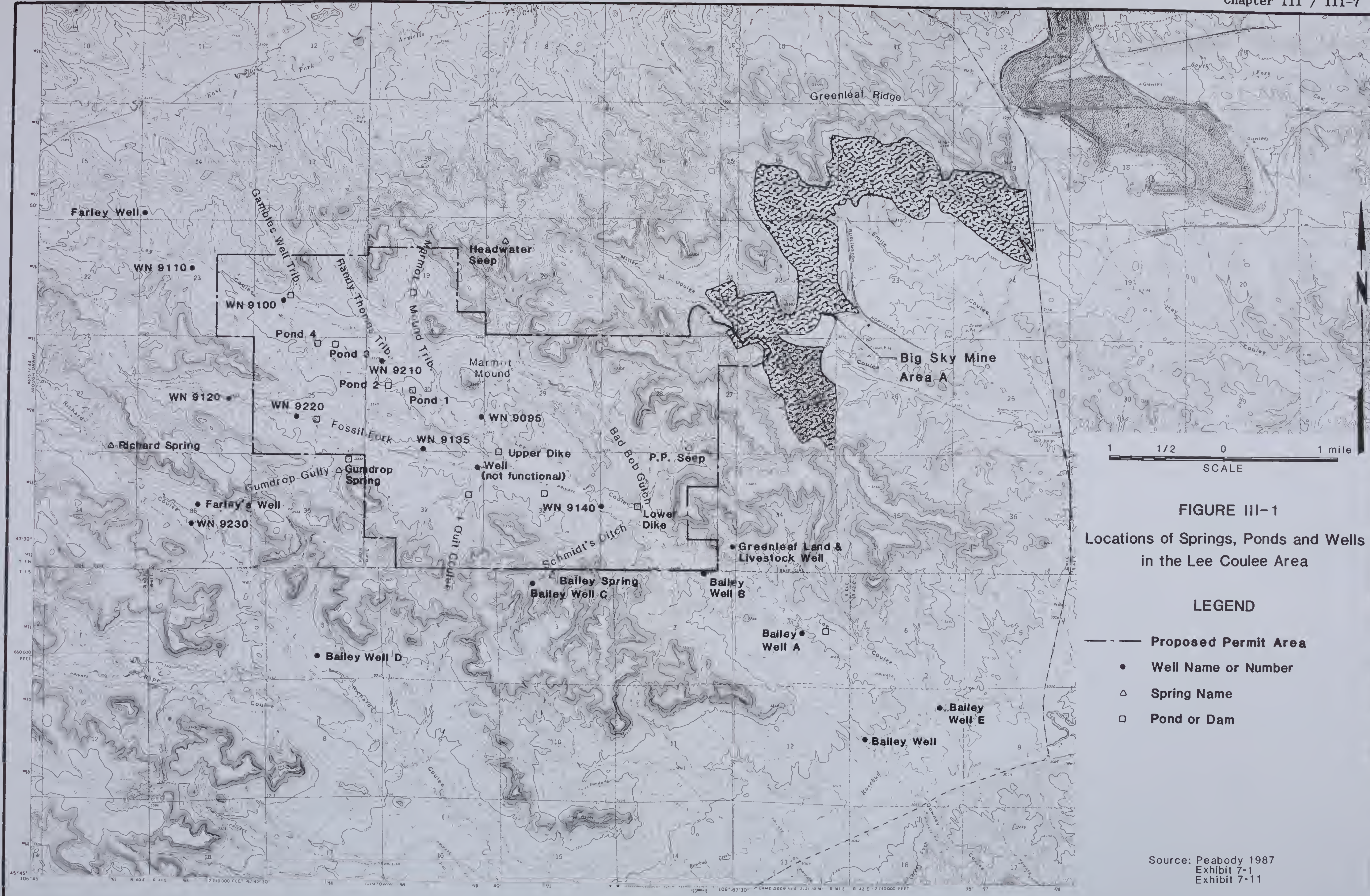
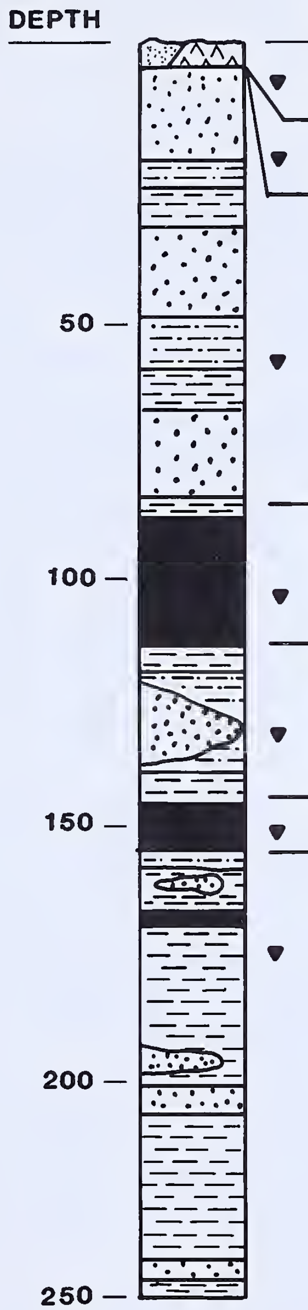
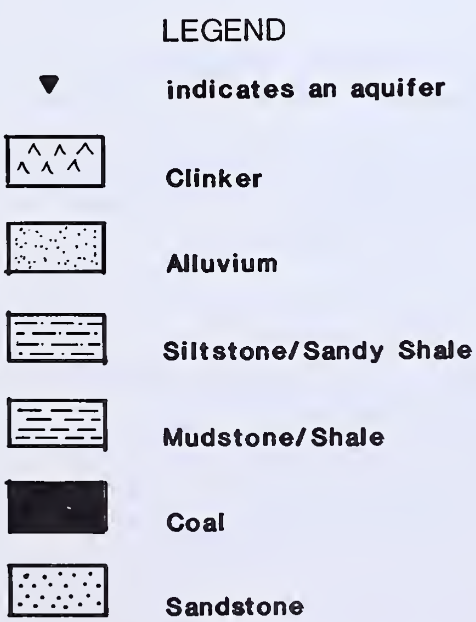


FIGURE III-1

Locations of Springs, Ponds and Wells in the Lee Coulee Area



BED	DESCRIPTION
Valley Alluvium and Suballuvium –	Shale, sand and gravel locally up to 40 feet thick.
Clinker	Sawyer Burn on ridge tops
Overburden –	Interbedded sandstone, siltstone and shale. Sandstone is dominant north of Lee Coulee while shale and siltstone are codominant south of Lee Coulee
Rosebud Coal –	Thickness ranges from 23 to 26 feet. Rosebud clinker exists in the central part of the permit area.
Interburden –	Predominantly siltstone and shale with increasing sandstone to the northwest. Thickness ranges from 10 to 70 feet.
McKay Coal –	Thickness ranges from 7.4 to 9.5 feet.
SubMcKay –	Shale and siltstone with sandstone lenses. Sandstone decreases to the southeast. A coal seam (Stocker ?) bed is present 12-21 feet below base of McKay Coal in the northwest half of area. Coal seam thickness varies from 0 to 2 feet. A second coal seam is present, 20 to 23 feet below the McKay Coal, in the extreme northwest corner of the area. This seam also ranges between 0 to 2 feet thick.



Sources: Peabody 1985, VanVoast 1977

FIGURE III-2

Generalized Stratigraphy
Big Sky Mine, Area B

Table III-2: Physical and Chemical Characteristics for Overburden, Interburden, and Underburden Material Determined Across the Entire Big Sky Mine Area B Study Area, Rosebud County, Montana, November, 1985

Parameter	Overburden Mean[1]	Overburden SD[2]	Interburden Mean[3]	Interburden SD	Underburden Mean[4]	Underburden SD
ph	8.05	0.21	7.73	0.32	8.25	0.34
Saturation, %	46.94	8.44	48.05	7.23	45.03	6.95
Salinity, mmhos/cm	1.91	1.39	1.92	0.40	1.75	0.63
Sodium, meq/l	5.40	4.72	8.21	5.43	11.86	4.76
Calcium, meq/l	7.81	6.79	6.68	3.13	3.35	4.04
Magnesium, meq/l	12.22	12.65	6.70	4.04	3.22	5.94
Sodium Adsorption Ratio	1.90	1.63	4.58	4.76	11.99	9.31
Carbonate, meq/l	0.01	0.01	0.06	0.13	0.09	0.18
Bicarbonate, meq/l	1.91	0.48	3.23	1.21	3.64	1.65
Nitrate, ppm	1.10[5]	1.06	0.55	0.34	0.69	0.40
Sulfate, meq/l	22.90	20.02	17.95	5.37	14.07	9.58
Exchangeable Sodium Percentage[6]	---	---				
Ammonium, ppm	8.13	4.85	18.51	6.94	14.61	9.00
Sand, %	47.88	24.55	21.47	14.62	21.05	14.05
Silt, %	33.85	15.71	54.00	10.60	55.64	10.26
Clay, %	18.27	9.52	24.53	6.64	23.31	5.96
Selenium, ppm	0.03	0.03	0.06	0.03	0.04	0.02
Molybdenum, ppm	0.23	0.13	1.58	3.33	0.32	0.17

Source: Peabody Coal Company 1987a.

[1] Each mean value includes 36 observation points.
[2] SD - Standard deviation.
[3] Each mean value includes 31 observation points.
[4] Each mean value includes 35 observation points.
[5] This mean was determined after omitting sites 5058E, 5066E, and 5087E. The mean and standard deviations with these two locations included are 9.10 ppm and 35.65 ppm, respectively.
[6] The mean and standard deviations were not calculated since the Exchangeable Sodium Percentage analyses were completed only when sodium adsorption ratio values exceeded 10.

In the upper portions of Lee Coulee, aquitards within the alluvium, overburden, and sub-McKay strata prevent most ground water from infiltrating into deeper strata. The ground water flows down to and laterally along the aquitards and appears at the surface in a 1.5 to 2.0 mile reach of Lee Coulee that remains wet much of the year. This 1.5-mile reach of stream is considered intermittent based on limited data. In lower Lee Coulee, the confining layers have been eroded away and the character of the rock changes. Water seeping downward does not encounter an aquitard, but flows into deeper strata, and does not reappear at the surface. Thus, within the permit area, surface flows in the upper wet reach of Lee Coulee may persist into summer, while in the lower reach the stream may be dry. Maximum flow measured in Lee Coulee is 140 cubic feet per second (cfs) (Montana Department of State Lands 1986a). Flows in tributaries of Lee Coulee have ranged from 0 to 25 cfs in Fossil Fork; 0 to 18 cfs in Bad Bob Gulch; 0 to 72 cfs in Schmidts Ditch; and 0 to 60 cfs in Marmot Mound tributary (Peabody Coal Company 1987a).

Springs in the study area are shown on figure III-1 and described in table III-3. Most of these springs flow from the overburden. The springs are used primarily by livestock and wildlife; several of them have been developed by excavating the area below the spring. Gumdrop Spring, P.P. Seep, Headwater Seep, and Richard Spring have been developed by excavating a small area below the spring or by diverting the spring into a stock tank. Little is known about Bailey Spring. Surface water flowing from springs located on side drainages generally does not reach Lee Coulee.

In Lee Coulee, several ponds and dikes have been constructed. The lower dike was built in 1938 to water livestock. The livestock pond silted in, the stream cut a new channel around the dike, and this impoundment no longer stores substantial amounts of water. The upper dike and associated ditches were used to flood-irrigate a field in Lee Coulee. This gravity irrigation system was abandoned in the 1950s and the landowners have no plans to irrigate this field. No alluvial valley floors have been designated in Lee Coulee to its confluence with Rosebud Creek (Montana Department of State Lands 1987).

Ponds 1, 2, 3, and 4 are located in the wet reach of Lee Coulee within the proposed disturbance area. The ponds intercept both surface water runoff from Lee Coulee and enough ground water flow to retain water through much of the summer. These ponds are used by both wildlife and livestock and are further discussed in the wildlife and aquatics sections of this EIS. Other water impoundments are delineated in figure III-1.

Surface water quality in the study area is generally good during runoff, but deteriorates in the impoundments and ponds as summer progresses. Plant transpiration and evaporation from the water surface tend to concentrate dissolved minerals, resulting in higher conductivities and concentrations of TDS in late summer. Water quality measurements of surface waters in the permit area are summarized in the Appendix. Complete data can be found in Peabody's application.

Table III-3: Characteristics of Springs and Seeps in the Vicinity of Area B

Name	Characteristics
Bailey Spring	Unknown. Located outside the permit area. Water rights have been filed on this spring.
Headwater Seep	Occurs at the base of clinker and near divide between Lee and Miller coulees and consists of a small depression in sandy soil. No flow from the depression was observed. Located outside permit area. No water right exists for this seep.
P.P. Seep	Seep from the overburden fills a small pond excavated in the coulee alluvium. No flow from the pond was observed during limited sampling. The pond may dry up by late summer. Although Peabody holds a water right in this area, it is for a well and not a spring.
Gumdrop Spring	Located on state-owned section (36) outside the permit area. The spring has been developed by excavating the overburden and backfilling with scoria. A wooden stock tank is filled from a steel pipe in the scoria. A reservoir is located several hundred feet downstream. The spring was observed flowing at 1.3 gal/min.
Richard Spring	Located about 1.1 miles to the west of the permit area. The spring has been developed in overburden sandstone and shows no signs of recent maintenance. It was observed flowing at about 0.2 gal/min. No water right exists.

Water quality in Rosebud Creek (see Appendix), a perennial stream located about 2.5 miles below the permit area, has been monitored by the U.S. Geological Survey (USGS) and Montana State University (Skagerboe et al. 1980, Knapton and McKinley 1977). Water quality of Rosebud Creek is suitable for stock water; however, data show low-sodium hazard and medium to very high salinity hazard when the water is used for irrigation. Salt-tolerant crops on well-drained soils may be irrigated with water from Rosebud Creek if

special management techniques are implemented. When the salinity hazard becomes very high, usually in late summer, the water is unsuitable for irrigation.

High TDS and sulfate concentrations generally render water from Rosebud Creek unsuitable for domestic use. Rosebud Creek is presently used for irrigation and stock water.

Ground Water

Several aquifers are present in the vicinity of Area B. Near the surface, shallow aquifers include the alluvium and the upper Tongue River member of the Fort Union Formation. The upper Tongue River member contains the coal seam to be mined. The lower Tongue River member below the coal to be mined, the Lebo shale, and the Tullock comprise the intermediate aquifer. The deepest aquifers include the Hell Creek Formation and the Fox Hills sandstone. Ground water flows to the north in the deep and intermediate aquifers, and to the southeast in the shallow aquifers. Intermediate and deep aquifers would not be affected by mining.

The most important shallow aquifers that may be affected by mining are the stream-bottom alluviums, the overburden located above the Rosebud coal, and the Rosebud coal. Physical characteristics of these aquifers are shown in table III-4 and their strata are depicted in figure III-2. More complete water quality data for each aquifer can be found in the Appendix.

The alluvium occur along the valley floors and receive recharge from surface runoff and other aquifers. TDS in the alluvium range from 436 milligrams per liter (mg/l) to 3,630 mg/l. Ground water in the Lee Coulee alluvium flows to the southeast along the stream course and into the Rosebud Creek alluvium. Water levels in the alluvium are influenced by seasonal streamflow events and evapotranspiration during the growing season.

Where present on the ridgetops and in the lower portion of Lee Coulee, the clinker comprises approximately 7 percent of the proposed permit area and serves as a local area for ground water recharge. Water from the clinker contributes to the Headwater Seep.

The overburden aquifer is composed of sandstone, siltstone, and shale of the upper Tongue River member. Water from this aquifer generally flows to the southeast and some discharges at the surface in the wet reach of Lee Coulee. Water in the overburden contributes to the flows of P.P. Seep, Gumdrop Spring, and Richard Spring. Ground water flow in the overburden aquifer is unconfined and there is at least some hydraulic connection between the overburden and the Rosebud coal. Water quality in the overburden is variable, depending on location. TDS concentrations range from 356 to 4,330 mg/l with an average of 1,276 mg/l. The maximum range of fluctuations in water levels in the overburden monitoring wells is less than 3 feet.

Table III-4: Aquifer Characteristics of the Big Sky Mine - Area B

Aquifer (ft^2/day)	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)	Storage Coefficient
Alluvium	Arithmetic Mean 226.2	12.18	1.91×10^{-3}
Overburden	Arithmetic Mean 23.7	.82	1.11×10^{-3}
Rosebud Coal	Arithmetic Mean 7.8	.31	4.42×10^{-5}
Interburden	Arithmetic Mean 13.1	.30	4.3×10^{-4}
McKay Coal	Arithmetic Mean 1.69	.29	10^{-5}
Sub-McKay Coal	Arithmetic Mean 1.35	.05	2.47×10^{-4}

Source: Peabody Coal Company 1987a.

The Rosebud coal aquifer lies below the overburden. Water in this aquifer flows to the southeast into Lee Coulee. TDS concentrations in the Rosebud coal average 2,324 mg/l and range from 574 to 4,550 mg/l. Both confined and unconfined flow conditions exist in the Rosebud coal aquifer. Water levels in monitoring wells have generally shown small fluctuations (less than 5.1 feet).

Ground water in the interburden also flows to the southeast. Artesian conditions are found in the northern and northwestern portions of the proposed permit area and change to unconfined conditions in the south and southeast. There is some hydraulic communication between the interburden and the McKay coal, but none was noted between the interburden and the overlying Rosebud coal. TDS concentrations in the interburden range from 422 to 3,830 mg/l with an average of 2,646 mg/l. Sodium concentrations are elevated along the southern boundary of the proposed permit area. Water level fluctuations in monitoring wells have generally been less than 5 feet.

The McKay coal is the deeper of the two coal layers in Area B. Ground water flow in the McKay is to the southeast. Water in the McKay coal aquifer has TDS concentrations between 1,590 and 3,610 mg/l with an average of 2,376 mg/l and water level fluctuations generally have been less than 2 feet. Both artesian and unconfined conditions are found in the McKay aquifer. Variations in water levels have been less than 10.6 feet.

The strata below the McKay coal include several aquifers. The upper part of the sub-McKay aquifer is composed of siltstone and shale, while the deeper aquifer is a sandstone about 50 to 100 feet below the McKay coal. The siltstone and shale are a poor source of water due to high concentrations of sodium and in some areas may serve as aquitards. TDS concentrations range from 1,200 to 4,750 mg/l in the upper part of the sub-McKay aquifier. Water quality data are not available for the deeper sandstone aquifer.

Locations of wells in the immediate vicinity of the proposed permit area are shown on figure III-1. Seventeen wells have been identified in the vicinity of the proposed permit area and all but one are used for stock watering. The other well is used by Peabody as a source of water for drilling as well as for stock water.

Water quality limits the potential uses of ground water in the study area. A high to very high salinity hazard (based on U.S. Department of Agriculture (USDA) criteria) is present in waters from the alluvium, overburden, interburden, and both coal seams; this limits the use of the water for irrigation. A medium to high sodium hazard restricts irrigation uses of ground water from the coals and the interburden.

AQUATIC LIFE

Lee Coulee

Aquatic sampling during June 1985 was limited to the three largest ponds in Lee Coulee (figure III-1). The numbered ponds (east = 1, middle = 2, west = 3) held substantial amounts of muskgrass (see Appendix for scientific names) and filamentous algae. Bulrushes grew around the shoreline of ponds 1 and 3, and pond 2 contained horned pondweed. The ponds covered 1,500 to 2,000 square feet and had maximum depths of 1 to 4 feet. Only pond 3 has been dredged to increase its capacity.

Sixty-seven kinds of macroinvertebrates were found in Lee Coulee (see Appendix). Both pond 1 and pond 2 had over 40 species. Pond 3 had a lower diversity due to the dominance of chironomid larvae. These dominant larvae, however, gave pond 3 the highest macroinvertebrate density. Microscopic water fleas (Daphnia spp.) occurred in all samples. No fish were found.

Weber (1973) related diversity indices to the condition of aquatic environments. The diversity indices for macroinvertebrates in ponds 1 and 2 indicated that the environments were unstressed (see Appendix). Pond 3 had diversity indices characteristic of stressed environments.

Rosebud Creek

Rosebud Creek supports a diverse and abundant population of aquatic macroinvertebrates (see Appendix). Most species were adapted to the turbid, silty conditions common in the prairie streams of eastern Montana. At the sampling site closest to Lee Coulee, Dipterans made up 77 percent of the bottom sample. Other taxa at this site were Coleopterans (8.8 percent), Trichopterans (7.9 percent), Oligopterans (3.2 percent), and Ephemopterans (2.7 percent). Further downstream, near the confluence with Cow Creek, Dipterans continued to dominate the sample (67 percent). Oligopterans and Coleopterons were also important (30 percent).

Twenty species of fish were found in Rosebud Creek downstream of its confluence with Lee Coulee (see Appendix). Most game fish were limited to the section immediately upstream of the Yellowstone River. Although northern pike were captured near Lee Coulee and Cow Creek, white suckers and shorthead redhorse dominated the samples.

SOILS

Nineteen soil series were mapped and described for the Big Sky Mine Area B. Two rock outcrops and one reclaimed land unit were mapped in addition to the soil series. Area B soils include deep loamy soils developed on alluvium; moderately deep to shallow loamy and sandy loam soils on colluvial footslopes; moderately deep to deep loamy soils developed on alluvium, colluvium, and residual parent material; and small areas of sandstone and shale outcrops.

Based on similarities in texture, parent material, slope angle, and in some cases, slope aspect, these soils have been placed into five categories:

--alluvial soils

--colluvial soils

--mixed alluvial/colluvial/residual soils

--rock outcrops

--aeolian soils

The location of these soil groups is shown in figure III-3. A complete listing of map units in areas proposed for disturbance and the amount of soil proposed for salvage are presented in the Appendix.

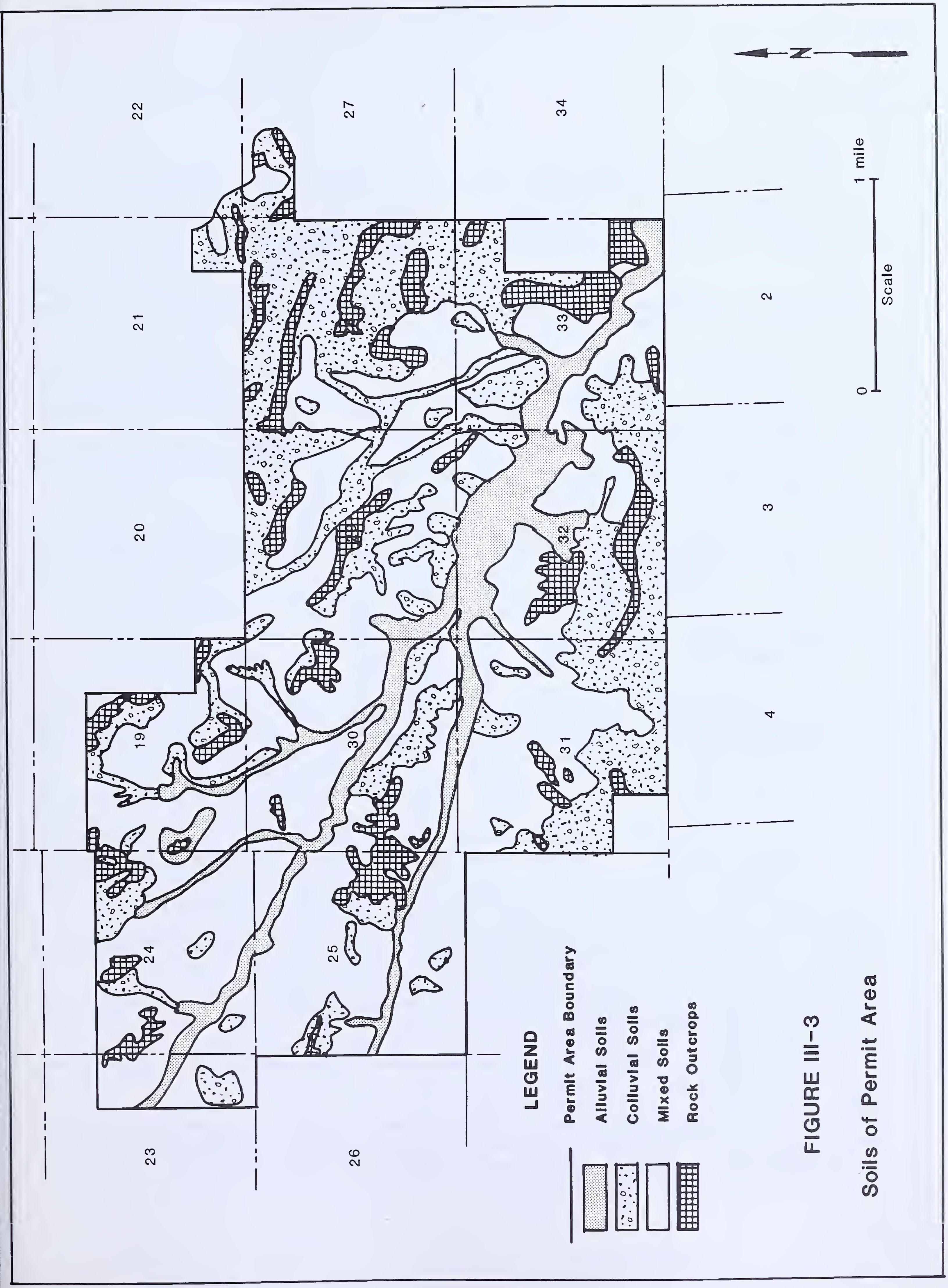


FIGURE III-3

Soils of Permit Area

Alluvial Soils

Alluvial soils cover about 9.2 percent of the proposed permit area and account for 513.5 acre-feet of the soil to be salvaged. The soils are generally deep, having developed from alluvial material.

Soil texture, chemistry, and vegetation vary due to soil parent material, topographic location, time, local climate, and organisms (especially vegetation) (Brady 1974).

The dominant soil texture is silty loam (ustic torrifluvents, typic fluvaquents) with fine silty clay loam (Yamac) and coarse silty loam (Lonna variant) occurring adjacent to the drainageway fluventic soils. In general, these soils become more coarse-textured with depth. The pH ranges from neutral to moderately alkaline (8.2). Soil mottling is common to the typic fluvaquent, Villy variant, and Yamac silty clay loam, as is its characteristic massive structure.

Alluvial soils are found along the Lee Coulee drainageway and in the lower reaches of side tributaries. Vegetation associated with these soils includes silver sage, big sage, wheatgrasses, needle-and-thread, fringed sage, prairie junegrass, and rabbitbrush.

Colluvial Soils

Soils derived primarily from sedimentary colluvium cover about 33.4 percent of the proposed permit area. These soils are developed on slopes ranging from nearly level to very steep and tend to be thin or very shallow on south slopes to moderately deep on north-facing slopes.

The Birney channery sandy loam and Birney-Cabbart complex, found on steep, north-facing slopes, are moist (because of aspect) and support relatively dense stands of ponderosa pine. The Rentsac channery sandy loam, however, is found on gentler slopes adjacent to the Birney soils and supports a sparser ponderosa pine forest. In addition to the Birney and Rentsac series, the colluvial soils include the following (see Appendix):

--Armells very gravelly loam, 6- to 25-percent slopes, variable aspect at the foot of colluvial slopes.

--Blackhall-Twilight-Busby sandy loam complex, 2- to 25-percent slopes, varied aspect on upland slopes.

--Rentsac-Armells very channery sandy loam complex, 6- to 35-percent slopes, varied aspect at slope base.

All of these colluvial soils have a channery, sandy, loam-dominated texture. They generally have low water-holding capacity, a neutral to slightly alkaline pH, and are generally well drained and moderately permeable.

The Grieves series (Ustic torriorthent) is classified with the colluvial soils because of its colluvial-dominated parent material, steep slopes (6 to 35 percent), and thin profile. Texture ranges from sandy loam to coarse loam, water-holding capacity is high, permeability is moderate, and pH is mildly alkaline. The soil is found in steeper tributary drainageway sideslopes and bottoms.

Ponderosa pine/grassland is the dominant vegetation type. Sagebrush and skunkbush are found on sites of finer soil texture.

Mixed Alluvial/Colluvial/Residual Soils

Soils in this group are developed from mixed alluvial, colluvial, and residual materials. These soils are found on gently sloping to rolling alluvial fans, sideslopes, terraces, and fan apron surfaces between plateaus, and make up nearly 54 percent of affected area in the proposed Area B. The Busby sandy loam dominates the group with the Forelle loam, also an important unit. The Cabbart and Davidell silt loams and Spang loam (derived from clinker) contribute 7.7 percent to the total in the affected area.

Textures range from deep, fine loams to coarse loamy, with a few coarse fragments scattered throughout. Water-holding capacity is generally high, permeability moderately slow to moderately rapid, and pH ranges from neutral to slightly acid. The Cabbart silt loam is the shallowest of this group with slow permeability and neutral to alkaline pH.

Sagebrush/grassland communities are the dominant vegetation type in this group. The Busby and Davidell soils were once farmed but now have a mix of native and non-native grasses, forbs, and shrubs. Only the shallow Cabbart, derived from mixed fine-grained sediments, supports occasional ponderosa pine.

Rock Outcrops

This group includes soils developed on rock outcrops, with limited or no soil or vegetation development. The Cabbart-Armells rock outcrop soils are shallow and occur on silty shale bedrock, while the Blackhall-Twilight complex occurs primarily on sandstone. The shale rock outcrop is found on approximately 85 acres in the southwestern portion of Area B north of Fossil Fork; has a high percentage of smectite clays; and is essentially devoid of vegetation. The sandstone rock outcrops are confined to ridgetops, knobs, and some associated sideslopes. These outcrop units comprise about 12 percent of the proposed affected area.

The Cabbart-Armells soils are shallow, loamy to loamy skeletal, well drained with medium to rapid surface runoff, and mildly alkaline. The sandier Blackhall-Twilight complex, derived from sandstone and siltstone, is loamy to coarse loamy; it is well drained, has moderately slow to moderately rapid permeability, and is neutral to mildly alkaline. Both complexes have

high coarse fragment content. Dominant vegetation is similar to that found on the soil series comprising the complexes.

Shale rock outcrops comprise approximately 3 percent (90 acres) of the proposed permit area and possess chemical and physical characteristics relatively inhospitable to the growth of vegetation. Although not extensively sampled, the soils from the shale rock outcrops have high clay content (especially smectite), high sodium content (as high as 111 milliequivalents per liter), and high sodium adsorption ratio (SAR).

The chemical and physical properties of soil from the soil rock outcrops render them especially susceptible to erosion when used in reclamation. The potentially toxic effects of sodium on vegetation coupled with their high clay content have been identified as factors which should be mitigated to enhance revegetation after mining.

Aeolian Soils

The Yetull loamy sand is found adjacent to and is derived from sandstone rock outcrops and comprises 2.3 percent of the proposed affected area. It is a deep, well-drained, sandy-textured soil with moderately rapid permeability, slow to very slow runoff, and neutral to mildly alkaline reaction. Ponderosa pine/grassland vegetation type is dominant with associated prickly pear, yucca, and silver sagebrush.

Soils Suitable for Reclamation

Soils most suitable for reclamation include the ustic torrifluvents, Yamac silty clay loam, and Lonna variant (alluvial); and the Busby sandy loam, Davidell silt loam, Forelle loam, and Spang loam (mixed alluvial/colluvial/residual soils). These soils comprise nearly 60 percent of the projected disturbance area and contain from 1.5 to 3 feet of salvageable soil material. The Villy variant, having moderately high salinity and SARs of 7 to 10, would be minimally salvaged. The Cabbart also would be minimally salvaged because of shallow depth and high percentage of coarse fragments.

Colluvial soils would be salvaged to a maximum of 1 foot. Steep slopes, high coarse fragment content, shallow depths, and in some cases the presence of ponderosa pine limit the amount of these soils that would be salvaged.

The rock outcrop soil complexes, comprising about 5.6 percent of the disturbance area, would be utilized when possible for ponderosa pine planting. The shale and sandstone rock outcrops would not be salvaged for soil.

About 1 foot of Yetull loamy sand would be salvaged. The sandy texture makes this soil vulnerable to erosion, but the small amount should not present a reclamation problem.

VEGETATION

Thirteen vegetation types were identified in the study area during 1984 baseline surveys (Peabody Coal Company 1987a, Volume 7). Grassland, shrubland, and ponderosa pine communities are the most prevalent types (table III-5). Coulee-bottom vegetation, although covering only 3 percent of the disturbance area, provides important habitat for wildlife and succulent forage for livestock. Areas without vegetation are sandstone outcrops, ponds and dams, and livestock facilities such as corrals, stock tanks, and abandoned buildings.

Table III-5: Vegetation Types in Area B Vegetation Study Area, 1984

Vegetation Type	Number of Sampling Transects	Number of Species Recorded[1]	Study Area		Disturbance Area	
			Acres	Percent	Acres	Percent
Needle-and-thread grassland	21	56	1,572	22.2	978	30.5
Sidehill grassland	15	59	687	9.7	411	12.8
Big sagebrush	21	44	942	13.3	398	12.4
Silver sagebush	22	39	779	11.0	485	15.2
Skunkbush sumac	11	43	275	3.9	95	3.0
Breaks complex	10	32	875	12.3	221	6.9
Ponderosa pine/grassland	20	60	1,279	18.0	314	9.8
Ponderosa pine/snowberry	2	48	50	0.7	12	0.4
Ponderosa pine/juniper	3	45	271	3.8	13	0.4
Deciduous tree	3	31	10	0.1	5	0.2
Mesophytic shrub	3	23	58	0.8	36	1.1
Riparian grass	6	29	54	0.8	49	1.5
Tame pasture	3	19	129	1.8	128	4.0
Annual grain	0	2	71	1.0	31	1.0
Miscellaneous disturbed	0	0	43	0.6	24	0.8
TOTALS	140		7,095	100.0	3,200	100.0

Source: Peabody Coal Company, 1987a (Volume 7).

[1]Many species were recorded in more than one type. Total number of species was 310.

A total of 310 plant species was recorded during field studies. The ponderosa pine/grassland and the sidehill grassland types had the greatest number of species (table III-5). The U.S. Fish and Wildlife Service (1984) does not list any threatened or endangered plant species in the study area; however, three species--Platte River milkvetch, small-flowered evening primrose, and prickly-poppy--appear on a Montana list of plants that are rare, threatened, endangered, extinct, or of undetermined status (Lesica et al. 1984).

Lesica (pers. comm., 1986) indicates that the Platte River milkvetch (see Appendix for scientific names) is more common than originally believed and will be deleted from any future list of threatened species. Although it has no legal protection, the small-flowered evening primrose is classified as rare (limited to a restricted geographic range or occurring sparsely over a wider area) by Lesica et al. (1984). In addition, the Montana Natural Heritage Program (1988) lists this primrose as critically imperiled in Montana (extremely rare or otherwise vulnerable to extirpation). The status of prickly poppy in Montana is undetermined because there is not enough information to determine whether it is rare, threatened, or endangered.

Based on Soil Conservation Service (SCS) methods (1983), most rangeland in the study area is in good condition (53 percent of climax). The riparian grass type has the highest rating, while the tame pasture type has the lowest (table III-6). However, tame pastures have good herbage yields due to the presence of highly productive increasers and invader grasses. Overall, range condition appears stable with declines noted mainly near water sources, salt stations, and corrals.

Vegetation Type Descriptions

Needle-and-Thread Grassland

Perennial grass cover in needle-and-thread grassland averages 38 percent, and is dominated in decreasing order by needle-and-thread, blue grama, western wheatgrass, and threadleaf sedge. Heavy silt or clay loams favor western wheatgrass, while coarser soils increase the proportion of needle-and-thread. On some sites, the percentage of blue grama has increased as taller or more palatable species have been reduced by grazing. Annual grasses, such as Japanese brome, are also common (20 percent cover). Common forbs include silverleaf scurfpea, scarlet globemallow, tarragon sagewort, and creeping white prairie aster. Shrubs, primarily big sagebrush, are widely scattered. Needle-and-thread grassland is the most extensive vegetation type in the study area, although it ranks fifth as a producer of livestock forage (table III-6).

Table III-6: Range Condition, Production, and Woody Plant Densities by Vegetation Type - Area B Study Area, 1984

Vegetation Type	Range condition[1]	Production of perennial grass and forbs (lbs/acre/year)	Production of shrubs[2] (lbs/acre/year)	Coniferous tree density (no./acre)	Shrub density (no./acre)[3]
Needle-and-thread grassland	Fair/47%	701	33	--	1,935
Sidehill grassland	Good/68%	742	49	--	519
Big sagebrush	Fair/42%	497	612	--	5,377
Silver sagebrush	Fair/34%	606	847	--	5,073
Skunkbush sumac	Good/60%	659	601	--	2,178
Breaks complex	Fair/50%	205	418	--[5]	3,359
Ponderosa pine/ grassland	Excellent/76%	253	65	275	8,633
Ponderosa pine/ snowberry	Good/70%	200	39	745	17,928
Ponderosa pine/ juniper	Fair/39%	120	199	687	7,338
Deciduous tree	--	--	--	--	--
Mesophytic shrub	Fair/46%	803	917	--	395,608
Riparian grass	Excellent/82%	4,113	0	--	0
Tame pasture	Fair/28%	1,491	19	--	--
Annual grain	--	--[4]	0	--	--
Miscellaneous[6]	--	--	--	--	--

Source: Peabody Coal Company (1987a, Volume 7).

--indicates that no estimate was made.
[1]Based on Soil Conservation Service (1983) methods. Number is percent of climax vegetation.
[2]Shrub production in all types except mesophytic shrub estimated by a non-harvest method (Weaver 1977).
[3]Number of live stems per acre. This number is not always identical to the number of plants per acre because some shrubs have multiple stems.
[4]A mean of 34 bushels per acre was produced from 1982 through 1984.
[5]A density of 30-40 ponderosa pine/acre was estimated for one of the four subtypes of the breaks complex.
[6]Disturbed areas, ponds and dams, sandstone outcrops.

Sidehill Grassland

Steeper slopes, coarser soils, and a greater proportion of warm-season species distinguish the sidehill grassland type from needle-and-thread grassland. Perennial grass cover in sidehill grassland averages 41 percent, with little bluestem, bluebunch wheatgrass, threadleaf sedge, and needle-and thread being the most common species. Little bluestem usually dominates hilltops characterized by coarse soils, and bluebunch wheatgrass prevails on lower slopes with finer soils. Japanese brome and other annual grasses have invaded much of the sidehill type (9 percent cover). Forbs, notably Hood's phlox, purple coneflower, and silverleaf scurfpea, are intermixed with the grasses. Shrubs are uncommon; yucca and skunkbush sumac make up only 3 percent of the total vegetation cover.

Big Sagebrush

Big sagebrush visually dominates this vegetation type, but silver sagebrush occurs occasionally in the overstory. Prairie junegrass and blue grama are the most common understory plants. Other perennial grasses and three species of annual grass occur sporadically beneath the sagebrush. Hood's phlox is the dominant forb. Shrubs produce more pounds per acre of annual growth than do herbaceous plants (table III-6).

Silver Sagebrush

The silver sagebrush type is found in drainageways or depressions and on uplands with coarse soils. Silver sagebrush and some big sagebrush make up the shrub overstory. Needle-and-thread is the most abundant grass on coarse-textured sites, while western wheatgrass dominates lowland sites. Other grasses include blue grama, Kentucky bluegrass, and green needlegrass. Common dandelion, scarlet globemallow, and common yarrow constitute most of the forb cover. Annual grasses (bromes and six-weeks fescue) are frequent.

Skunkbush Sumac

The skunkbush sumac type often occurs on south slopes of sandy knolls and on clinker ridges. It also occurs next to sandstone outcrops and stands of ponderosa pine. Skunkbush sumac dominates the shrub overstory. Grass cover under the shrubs averages 33 percent. Important grasses include blue grama, needle-and-thread, and bluebunch wheatgrass. Brome grasses and other annual grasses reach 8 percent cover. Forbs cover slightly less area than annual grasses. Wavyleaf thistle, common salsify, tarragon sagewort, and silverleaf scurfpea are common. Livestock forage production and shrub production are similar (table III-6).

Breaks Complex

The breaks complex is characterized by rugged topography and highly erodible, poorly developed soils. Vegetation cover is comparatively sparse and grass and forb production is low. Bluebunch wheatgrass and thickspike wheatgrass account for most of the 9 percent grass cover. Forbs scattered throughout the type include few-flowered buckwheat and scarlet globemallow. Big sagebrush and skunkbush are found infrequently. Patches of ponderosa pine grow adjacent to sandstone outcrops.

Ponderosa Pine/Grassland

Ponderosa pine is found on all aspects of the ponderosa pine/grassland community but seems to prefer slopes facing north or east. Soils are generally coarse and derived from clinker or sandstone. Canopy cover of ponderosa pine varies with site conditions, ranging from 10 to 57 percent. As canopy cover increases, herbaceous production by understory plants decreases. Skunkbush sumac contributes a small amount of shrub cover. Forb species include common yarrow, field chickweed, and prairiesmoke. Bluebunch wheatgrass, sideoats grama, and sun sedge account for most of the 16 percent perennial grass cover.

Ponderosa Pine/Snowberry

The ponderosa pine/snowberry vegetation type is limited to steep, north-facing slopes and drainage bottoms, and, therefore, covers only a small portion of the study area. Ponderosa pine and occasional Rocky Mountain junipers form a canopy cover of 31 percent. Although western snowberry grows densely below the coniferous canopy, the shrub size is small. Hence, shrub cover is only 2 percent. Squaw currant and poison ivy are other noticeable shrubs. Forb cover averages 14 percent and is highest in drainage bottoms. Prairiesmoke is the most common hillside forb and prairie milkvetch prevails in the draws. Draws and slopes have a combined grass cover of 10 percent. Bluebunch wheatgrass, little bluestem, and sun sedge share dominance in draws. Small needlegrass is the most abundant grass on slopes.

Ponderosa Pine/Juniper

The ponderosa pine/juniper type is restricted to the north aspects of steep slopes. The coarse soils are developed from clinker or sandstone. Nearly equal densities of ponderosa pine and Rocky Mountain juniper make up the 24 percent tree canopy. Shrub cover reaches 4 percent with skunkbush sumac and big sagebrush recorded most frequently. Bluebunch wheatgrass, prairie junegrass, sun sedge, and sideoats grama account for most of the 9 percent grass cover. Forbs provide slightly less cover than grasses. Common yarrow and field chickweed are readily noticeable.

Deciduous Tree

Patches of plains cottonwoods or box elders grow only along Lee Coulee and other major coulees with shallow ground water tables in the plant rooting zones. A canopy cover of 50 percent is formed by a tree density of three cottonwoods and three box elders per acre. Beneath forest overstory, hawthorn, plum, and chokecherry form a 15 percent canopy cover of tall shrubs. Livestock use has nearly eliminated low-growing shrubs from this type. Kentucky bluegrass, slender wheatgrass, foxtail barley, and annual brome grasses are abundant. Annual forbs such as smallpod tumblemustard and catchweed intermix with common dandelion, burdock, and stinging nettle.

Mesophytic Shrub

This type usually borders the deciduous tree or riparian grass types and is occasionally found adjacent to mesic ponderosa pine or silver sagebrush stands. Western snowberry comprises 90 percent of the shrub cover. Soil texture apparently determines whether warm-season or cool-season grasses grow beneath the snowberry. Common grasses include western wheatgrass, green needlegrass, sideoats grama, and little bluestem. However, Kentucky bluegrass has invaded much of the type and has become the dominant grass. Forbs such as horsemint and stiff goldenrod commonly occur.

Riparian Grass

The riparian grass type is confined to the bottoms of large coulees. The coulee bottom channel provides sufficient moisture for dense prairie cordgrass and American bulrush. Prairie cordgrass becomes dominant on alkaline soils. Nebraska sedge and common spikesedge are subdominant species on wet sites, merging to slender wheatgrass and foxtail barley on drier sites. A band of panicgrass and clustered field sedge borders the drainage channel. Edges of major coulees typically support foxtail barley and clustered field sedge. Tufted white prairie aster is the dominant forb in the riparian grass type. Only trace amounts of annual grasses and woody species can be found. This type produces more livestock forage per acre than any other vegetation type.

Tame Pasture

Approximately 25 years ago, some areas adjacent to Lee Coulee were planted with crested wheatgrass, and in following years, several native grasses recolonized the pastures. Presently, the pastures are composed of crested wheatgrass (22 percent cover), needle-and-thread (6 percent), western wheatgrass (4 percent), Kentucky bluegrass (4 percent), and intermediate wheatgrass (2 percent). Annual brome grasses and six-weeks fescue are also common. Forbs occur infrequently and include creeping white prairie aster, common dandelion, and scarlet globemallow.

Annual Grain

In 1980, a field of winter wheat was reestablished in the northern half of Section 32. This field is cultivated annually, but no longer relies on flood irrigation from Lee Coulee and is not classified as prime farm land.

WILDLIFE

The topography and vegetation of the wildlife study area provide habitat for over 100 wildlife species. Mule deer use the area year-round and pronghorn are occasionally observed (see Appendix for scientific names). Other wildlife groups include birds of prey (raptors), waterfowl, and upland gamebirds.

The study area is characterized by ridges and mesas with steep slopes that gradually taper into benches and flats. Greenleaf Ridge borders the north side of Emile Coulee. Small drainages cut through low-lying areas to join Emile, Miller, Lee, and Richard coulees (figure III-4). These four large coulees drain into Rosebud Creek. Numerous sandstone outcrops supply cover and nest sites for birds of prey and songbirds.

Lee Coulee bisects the proposed permit area and provides aquatic habitat and water for wildlife. Wildlife use of Lee Coulee varies with the availability of water (see Hydrology - Chapter III). Water for wildlife may also be supplied by wells with stock tanks and sources outside of the proposed permit area (see figure III-1). Wildlife habitat types (see table III-7) are based on vegetation and correspond to previously described vegetation types (see Vegetation - Chapter III). Most of the study area consists of grassland types; however, riparian habitat occurs along Lee Coulee.

Mule Deer

In each of the 13 years of wildlife surveys, the most frequently observed large mammal was the mule deer. The number of observations was influenced by natural factors (i.e., weather, regional population size, habitat conditions) and by sampling intensity. Regular ground surveys and 22.5 hours of aerial survey in 1982 yielded 530 observations (2,466 individuals). In comparison, 108 deer groups (608 individuals) were seen during the 8 hours of aerial survey conducted in 1985 (table III-8).

Observations by Peabody biologists in 1982 showed that mule deer were widely distributed throughout the study area. Due to relatively severe weather during late winter and high sampling intensity, 1982 was chosen to represent deer distribution. No important wintering areas were evident, although many deer were sighted in reclaimed lands in Miller Coulee and in the adjacent Greenleaf Ridge area.

Table III-7: Wildlife Habitat Types and Corresponding Vegetation Types

Wildlife Habitat Type	Disturbance Area		Corresponding Vegetation Type(s)
	Acres	Percent	
Grassland	1,389	43.0	Needle-and-thread, sidehill grasslands
Big sagebrush/grassland	398	12.0	Big Sagebrush
Silver sagebrush/grassland	485	15.0	Silver Sagebrush
Clinker-clay outcrops	221	7.0	Breaks Complex
Creek or coulee bottom	90	3.0	Deciduous tree, mesophytic shrub, riparian grass
Sandstone outcrop	8	Trace	Miscellaneous
Ponderosa pine/grassland	339	11.0	Ponderosa pine types (3)
Skunkbush/grassland	95	3.0	Skunkbush sumac
Agricultural areas	159	5.0	Tame pasture, annual grain
Reclaimed	0	0.0	None
Miscellaneous	16	1.0	Miscellaneous
TOTAL	3,200	100.0	

Source: Peabody Coal Company, 1987a; Peabody Coal Company, pers. comm., 1988.

The Montana Department of Fish, Wildlife and Parks (DFWP) identified the eastern part of the proposed permit area as winter range. Most of this range consists of the ponderosa pine habitats on either side of Lee Coulee. Lower Lee Coulee and Greenleaf Ridge accounted for most spring observations. During summer and fall, deer tended to use areas bordering Lee Coulee.

Mule deer used a variety of habitat types (table III-9). The ponderosa pine/grassland type supplied thermal cover in the winter and shade in the summer. Shrub habitats were used year-round and provided winter browse. Reclaimed areas, grasslands, and agricultural lands contain nutritious and palatable forages that attract deer. However, as in 1985, drought and excessive livestock grazing can reduce deer use in these types.

Variations in deer observations and deer population density (table III-8) generally correspond to changes in regional (southeastern Montana) deer populations. Weather, disease, predation, and hunting can cause populations to fluctuate. The 1986 fawn:doe ratio indicates that productivity is slightly above the 12-year average (table III-8).

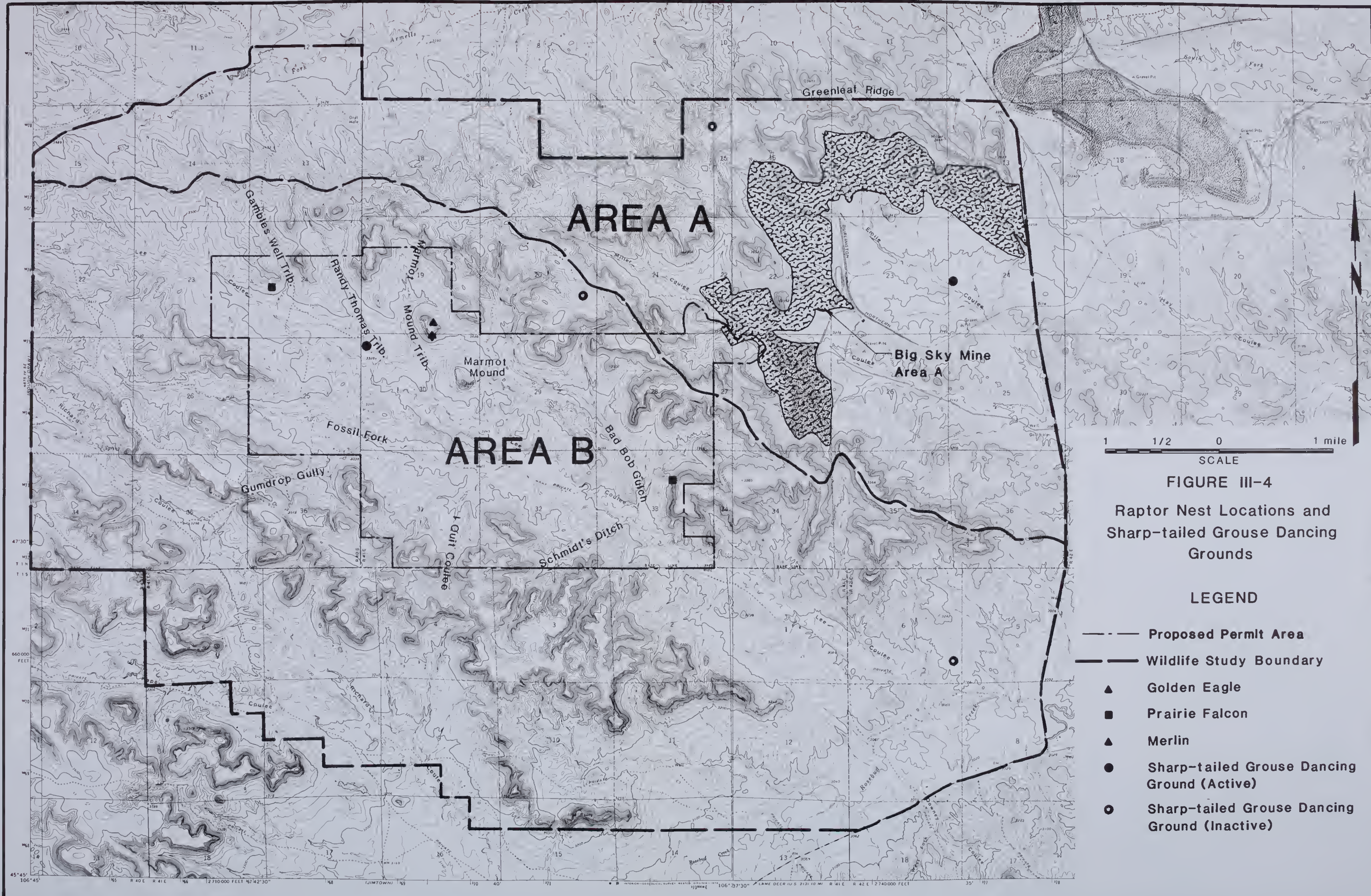


FIGURE III-4

Raptor Nest Locations and Sharp-tailed Grouse Dancing Grounds

Table III-8: Mule Deer Observed in the Big Sky Mine Wildlife Study Area, 1974-1985

Year	Groups Observed	Individuals Observed	Fawns per 100 does	Hours of Aerial Survey	Deer/hr of Aerial Survey	Deer per Square Mile[1]
1974	57	224	--	8.4	14.5	2.2
1975	60	196	73	10.7	15.2	1.7
1976	111	438	58	14.3	25.4	3.0
1977	120	507	56	17.4	25.9	2.6
1978	115	509	122	15.6	26.0	3.1
1979	146	733	57	15.0	36.9	5.2
1980	133	530	83	16.5	16.1	1.7
1981[2]	356	1,738	94	21.2	37.6	4.6
1982	530	2,466	89	22.5	60.4	6.9
1983	342	1,696	123	8.7	92.9	7.2
1984[3]	139	942	108	6.5	106.3	7.4
1985	108	608	82	8.0	68.6	4.1
1986	115	447	90	9.9	45.2	4.1

Source: Peabody Coal Company, 1987a (Volume 8).

[1] Based on aerial surveys only.
[2] Study area increased from 30 square miles to 34 square miles.
[3] Systematic ground surveys eliminated. Study area increased from 34 square miles to 49 square miles.

Pronghorn

Pronghorn infrequently used Lee Coulee and the surrounding ridges. Most pronghorn were observed north or west of the wildlife study area. Six sections of potential pronghorn range have been identified within or adjacent to the western part of the study area. Portions of two of these sections are within the proposed permit area. The study area apparently lacks sufficient open and gently sloping terrain to attract pronghorn. Most pronghorn seen in the study area (77 percent of the 1986 observations) used the grassland habitat type.

In 1986, 32 pronghorn groups (162 individuals) were observed in the study area. During the 13 years of study, the average number of groups observed each year was 23 (127 individuals). The 1986 fawn:doe ratio of 88:100 is above the 45:100 and 78:100 ratios noted for the preceding years. The lowest ratios (average of 36:100) were recorded in the mid-1970s, while the highest ratio (150:100) occurred in 1983.

Table III-9: Mule Deer Habitat Use, Big Sky Mine Wildlife Study Area, 1982-1985

Year	Percent of Groups Observed in Each Habitat Type[1]							
	Pine/ grassland	Skunkbush/ grassland	Big sage/ grassland	Silver sage/ grassland	Grassland	Reclaimed	Agriculture	Others
1982								
Winter (severe)[2]	11	4	3	36	18	17	11	0
All seasons	21	7	5	24	15	19	9	0
1983								
Winter (mild)	14	11	6	31	16	16	6	0
All seasons	13	10	5	29	13	21	9	0
1984								
Winter (Mild)	15	0	5	36	29	0	13	2
All seasons	15	1	19	24	8	8	16	9
1985								
Winter (severe)	28	18	33	9	0	0	0	12
All seasons	23	16	29	16	4	0	6	6
1986								
Winter (mild)	31	14	6	30	6	10	0	1
All seasons	24	9	13	21	8	16	5	54

Source: Peabody Coal Company, 1982-86.

[1]See Table III-7 for sample sizes. Percentages do not total 100 due to rounding.
[2]Classification based on average January temperature and January through March precipitation at Colstrip, 1974-86 (National Oceanic and Atmospheric Administration, 1974-86).

Other Mammals

Coyotes were regularly observed throughout the study area. They ranged through all habitat types, but were most frequently sighted in the sagebrush/grassland types. Other predators recorded were bobcats, long-tailed weasels, badgers, and striped skunks. White-tailed jackrabbits, thirteen-lined ground squirrels, cottontails, porcupines, red squirrels, yellow-bellied marmots, and least chipmunks also inhabited the study area.

In 1986, Peabody trapped small mammals in the grassland, big sagebrush/grassland, silver sagebrush/grassland, ponderosa pine/grassland, and creek/coulee bottom habitat types, and reclaimed areas. Deer mice, trapped in all habitat types, made up 67 percent of the total catch. Meadow voles, western harvest mice, sagebrush voles, western jumping mice, and bushy-tailed woodrats were also trapped. Big sagebrush/grassland, accounting for 22 percent of the captures, provided the best habitat.

Upland Gamebirds and Waterfowl

Sharp-tailed grouse were commonly sighted in the study area. Observations ranged from 54 birds in 1986 to 577 birds in 1980. This range reflects both regional population fluctuations and sampling intensity. The 1986 population density was estimated at 1.2 birds per square mile. Low populations are often attributed to severe winters, summer droughts, and increased local hunting.

Each spring, grouse gather at traditional dancing grounds for courtship. The study area has three inactive grounds and two active grounds (figure III-4). One of the active dancing grounds, used by an average of 13 males each year, is within the proposed disturbance area.

Wild turkeys were first observed in the study area in 1981. The turkeys relied on ponderosa pine forests and favored areas along Greenleaf Ridge. Observations fell from 83 birds in 1984 to 34 birds in 1986. Gray partridge and ring-necked pheasants were occasionally sighted in agricultural or reclaimed lands.

Waterfowl use was limited to ponds in reclaimed areas and along Lee Coulee. Mallards, the most common waterfowl species, sometimes nested near reconstructed ponds. Canada geese rested in the large DNRC pond during spring migration. Other waterfowl observed included green-winged teal, blue-winged teal, and American widgeon.

Birds of Prey (Raptors)

Eleven birds of prey species reside in the study area. Golden eagles, turkey vultures, red-tailed hawks, and rough-legged hawks were sighted soaring over the area. Smaller hawks (Cooper's hawk, sharp-shinned hawk), falcons (American kestrel, prairie falcon), northern harriers, ospreys, and great horned owls also were observed.

The number of active raptor nests has fallen from 15 in 1984 to 3 in 1986 (figure III-4). Peabody Coal Company (1987a, Volume 8) speculates that the decline was caused by a falling prey base. Two prairie falcon pairs maintained nests at opposite ends of the proposed permit area, but only the eastern nest produced young in 1986. A merlin nest on Marmot Mound also successfully produced young. Between 1982 and 1984, golden eagles were fledged from a nest in the proposed permit area. Since 1985, eagles have placed additional material on the nest but have not raised young. Ponderosa pine trees supply nest sites for red-tailed hawks (five nests were located in 1985). Extensive nesting by kestrels probably occurs throughout the study area. Records show that the proposed permit area contains suitable nest sites for great horned owls and long-eared owls.

Songbirds

In 1986, Peabody counted songbirds in seven habitat types. The coulee/creek bottom type had the most diverse population with 28 species identified; the most common were the red-winged blackbird and western meadowlark. Ponderosa pine/grasslands accounted for 19 species; the chipping sparrow was the most abundant. Other habitat types (grassland, silver sagebrush/grassland, and reclaimed areas) had less diverse populations (five to eight species). Western meadowlark was the most-often-observed species in the grassland habitats and in reclaimed areas.

Reptiles and Amphibians

Eight reptile and five amphibian species were recorded in 1986. The ponds in Lee Coulee served as habitat for garter snakes, painted turtles, frogs, and toads. Amphibians also inhabited reconstructed ponds in the Area A wildlife study area. Prairie rattlesnakes, bull snakes, and hognose snakes were frequently observed crossing roads. Sagebrush lizards live in sandstone outcrops.

Threatened and Endangered Species

Pursuant to Section 7 of the Federal Endangered Species Act, OSMRE consulted with USFWS regarding the presence of endangered species in the vicinity of the Big Sky Area B Mine. USFWS identified the black-footed ferret, bald eagle, and peregrine falcon as species that could occur within or near the proposed mining area. Black-footed ferrets are usually

associated with prairie dog towns, none of which exist in the study area. Since 1982, no bald eagles or peregrine falcons have been observed in the study area.

FISCAL

Rosebud County

The tax base in Rosebud County has doubled since 1980, largely due to coal mining and the completion of the Colstrip power plants. Table III-10 illustrates the total taxable valuation of property in Rosebud County and the percent of the total for various property classes. In 1987, 91.5 percent of the taxable valuation was in four categories: mining and manufacturing machinery (including pollution control equipment); utilities; net proceeds from oil production; and gross proceeds from mining. The net proceeds tax decreased dramatically in 1987 due to the decline in oil prices.

Per capita taxable valuation of $19,500 in 1986 for Rosebud County was 6.8 times the state average. This high taxable valuation allows Rosebud County to have one of the lowest mill levies in the state. Table III-11 shows mill levies and taxes for various purposes for fiscal years 1985-86 and 1986-87. The 1986 total county-wide levy was 100.74 mills, which was 44.8 percent of the state-wide average.

Forsyth

The taxable valuation of the town of Forsyth for the years 1981 through 1986 is shown in table III-12. None of the energy facilities that account for the highest proportion of the Rosebud County tax base is located in Forsyth. Mine and power plant workers who live in Forsyth and businesses that serve energy industry workers contribute to the tax base of the town and to the demand for municipal services.

School Districts

Rosebud County schools also benefit from the large county tax base. In 1986, approximately 70 percent of school funding in Rosebud County came from local sources, 5 percent from the state, 15 percent from the federal government, and the remainder from other sources such as tuition. This breakdown compares with state-wide averages of 41 percent local funding, 48 percent state funding, and 7 percent federal funding (Shackleford 1988).

Schools with mines and energy facilities in their districts have benefitted the most from development. On the average, 38 percent of Rosebud County school funding came from district levies and 34 percent from county-wide levies. The contribution of district levies ranged from 60 percent for Colstrip High School to 8 percent for Ashland to less than 1 percent for Lame Deer (Montana Department of Commerce 1987).

Table III-10: Taxable Valuation, Rosebud County

Item	1981	1982	1983	1984	1985	1986	1987
Total taxable value (1000s)	$121,208	$163,639	$222,617	$244,364	$237,854	$218,881	$224,690
Agricultural land	2.29%	1.70%	1.26%	1.18%	1.20%	1.31%	1.28%
Non-ag land and improvements	10.39%	2.43%	2.07%	2.13%	1.89%	2.23%	2.44%
Mining and manufacturing machinery, new industrial property and pollution control	17.39%	0.66%	3.19%	4.26%	6.05%	7.42%	5.83%
Utilities	0.00%	0.00%	0.02%	0.01%	57.01%	51.27%	63.63%
Net proceeds	11.16%	13.93%	11.87%	8.07%	8.27%	7.59%	1.46%
Gross proceeds	25.44%	23.43%	17.47%	17.02%	21.34%	23.47%	20.54%
Other	33.32%	57.84%	64.13%	67.34%	4.23%	6.72%	4.81%

Source: Montana Department of Revenue, 1981-86; Montana Department of Revenue, 1987.

Table III-11: Mill Levies and Taxes, Rosebud County

Item	1985-86 Mills	1985-86 Levy	1986-87 Mills	1986-87 Levy
State Purpose				
University	6.00	1,427,126	6.00	1,291,621
Livestock		55,107		50,362
County Purpose				
General Fund	6.44	1,453,299	1.48	587,572
Road Fund	5.86	1,342,575	7.13	1,448,808
Bridge Fund	0.28	72,639	0.46	89,428
Poor Fund	0.62	174,249	0.89	177,279
County Fair	0.73	163,111	0.43	109,258
Library	0.22	52,920	0.50	91,973
Hospital	0.18	43,928	0.18	39,771
Airport	0.35	76,638		18,755
Weed Control	0.19	55,022	0.28	56,148
Senior Citizens	0.11	30,408	0.16	31,411
Other	0.15	50,519	0.24	45,768
School Purpose				
Elementary	44.64	10,748,039	49.12	10,306,405
High School	34.97	8,234,471	38.26	8,035,030

Source: Montana Department of Revenue, 1984-86.

Table III-12: Taxable Valuation, City of Forsyth

Year	Taxable Valuation
1981	$2,172,494
1982	$2,017,099
1983	$2,006,753
1984	$2,131,015
1985	$2,167,602
1986	$2,499,628

Source: Montana Department of Revenue, 1981-86.

State and Federal Taxes

Rosebud County coal mines also pay federal corporate income taxes and pay royalties on any state, federal, and tribal coal that they mine. Rosebud County coal mines also pay state severance taxes and Resource Indemnity Tax, both based on the value of production. Table III-13 shows total production and the value of coal produced by Rosebud County mines from 1982 through 1986. The 1987 Legislature changed severance tax rates and made future rates contingent on levels of production in 1987. The rate is scheduled to decrease to 25 percent on July 1, 1988, to 20 percent on July 1, 1990, and to 15 percent on July 1, 1991. The Resource Indemnity Tax is $25 per year plus 0.5 percent of the gross value of output over $5,000.

Table III-13: Coal Production, Rosebud County

Year	Production Tons	Gross Value
1982	12,355,653	$118,654,634
1983	12,141,044	$126,801,143
1984	15,844,946	$154,102,894
1985	15,616,857	$130,604,205
1986	14,674,254	$142,291,619

Source: Montana Department of Revenue, 1982-86.

EMPLOYMENT

Rosebud County

Energy development in the 1970s and 1980s changed the focus of the economic base of Rosebud County from agrarian to industrial. The development of two major coal mines and four coal-fired electrical generating units created nearly 1,200 high-paying basic jobs in Rosebud County (table III-14). In addition, coal shipments from the mines have increased railroad employment by almost 100 jobs.

Table III-14: Energy Development, Rosebud County, 1968-1985

Activity	Operator	Date Opened	Employment 1987/1988
Rosebud Coal Mine	Western Energy	1968	382
Big Sky Coal Mine	Peabody Coal	1969	114
Colstrip Units 1 and 2	Montana Power	1976	270
Colstrip Units 3 and 4	Montana Power	1984	415
TOTAL			1,181

Sources: Western Energy Company, 1988; Peabody Coal Company, 1988; Montana Power Company, 1988.

While agriculture continues to contribute to the economic base of Rosebud County, it is no longer as vital as in the past. Government services, a U.S. Air Force radar station, lodging, retail and service business sales to non-local residents, non-locally funded medical services, private educational services, and the forest products industry also contribute to the area's economic base. State and federal government transfer payments (e.g., social security payments) also add to the economic base of the county.

Increases in local expenditures resulting from energy development have led to substantial growth for Rosebud County secondary-sector businesses (e.g., retail, service businesses) and expansion of services provided by local governments and schools. With construction of Colstrip Generating Units 3 and 4 completed, however, businesses in Rosebud County are now adjusting to lower, but more stable, levels of activity.

Economic growth related to energy development has resulted in substantial increases in the size of the labor force and the number of people employed in Rosebud County. From 1970 to 1983, the annual average size of the county labor force increased from about 2,700 to 7,800, while the number of employed persons increased from about 2,600 to 7,100 (table III-15). Peak employment for the construction of Colstrip Generating Units 3 and 4 occurred in 1983. Since that time, many construction workers have left the county. In 1987, the Rosebud County labor force was reported to be approximately 5,100 with 4,600 persons employed and 500 persons unemployed (Montana Department of Labor and Industry 1988).

Table III-15: Labor Force, Employment, and Unemployment Figures For Selected Years, Rosebud County

Year	Labor Force	Employed	Unemployed	Unemployment Rate
1960	2,269	2,118	151	6.6%
1970	2,690	2,606	84	3.1%
1971	2,738	2,657	81	3.0%
1973	3,195	3,055	130	4.1%
1975	5,169	4,948	221	4.3%
1977	3,976	3,705	271	6.8%
1979	4,587	4,357	230	5.1%
1981	6,128	5,696	432	7.0%
1983	7,779	7,061	713	9.2%
1985	5,663	5,016	647	11.4%
1986	5,476	4,906	570	10.4%
1987	5,106	4,617	489	9.6%

Sources: U.S. Department of Commerce, Bureau of the Census, 1960; Montana Department of Labor and Industry, Fourth Quarter, 1971-1988.

Unemployment rates in Rosebud County have fluctuated between 3 and 11 percent since 1960. During the early years of energy development, the county experienced periods of relatively low unemployment. Unemployment rates increased over time as the prospects of high-paying jobs brought many people to the area. In the mid-1980s, following the conclusion of power plant construction, the county experienced high unemployment rates (above 10 percent). The chronically high unemployment rate among the Northern Cheyenne also has contributed to higher-than-average county unemployment rates in the 1980s.

Forsyth and Colstrip

Forsyth and Colstrip are the commercial centers of Rosebud County. Although Forsyth had a well-developed commercial district before energy development, merchants have benefitted from expansion of the economic base and related population growth in the county. Forsyth provides county residents with the greatest variety of retail goods and services. The operation of Peabody's Big Sky Area A Mine is important to the economy of Forsyth. Over half of the 113 Peabody employees live in the Forsyth area.

Commercial development in Colstrip has gradually developed since the advent of energy development. Most businesses were started by persons who initially moved to Colstrip because of job opportunities associated with energy development (L. Miller, pers. comm., 1986). The number of businesses in Colstrip continued to increase even after the power plants were completed (L. James, pers. comm., 1986). However, commercial development in Colstrip is less than is typical for Montana communities with populations of 4,000 persons. About one-third of Peabody employees live in or near Colstrip.

Northern Cheyenne Indian Reservation

Portions of the Northern Cheyenne Reservation are located in both Rosebud and Big Horn counties. The reservation economy is partially affected by the performance of basic industries located off the reservation, but businesses operating exclusively on the reservation are also important economically to the Northern Cheyenne.

Federal and tribal government services are the most important sources of basic employment on the Northern Cheyenne Reservation. Educational services, agriculture, construction, manufacturing, and forest products operations are also basic economic components.

The economy of the Northern Cheyenne Reservation has experienced some benefits as a result of energy developments in both Rosebud and Big Horn counties (table III-16). In addition to the Colstrip generating units and the Big Sky Area A and Rosebud coal mines operating in Rosebud County, the Spring Creek, Absaloka, and Decker coal mines in Big Horn County are within commuting distance of the reservation.

Labor force and employment characteristics for Northern Cheyenne Indians are different than for non-Indians living in Rosebud County. Since 1970, the number of Native Americans in the labor force has doubled (table III-17).

Employment of the Northern Cheyenne has fluctuated from year to year, but lack of jobs has always been a problem on the reservation (J. Buffalo Horn, pers. comm., 1986). Employment of tribal members reached its greatest level in 1983, when Colstrip power plant construction was at its peak and when a major housing construction project was underway on the reservation. With completion of these activities, unemployment among tribal members increased dramatically. Currently, over half of the Native Americans in the labor force are unemployed, and many of those who are employed hold part-time jobs (Feeney et al. 1986; R. Bailey, pers. comm., 1988). Ten Peabody employees are Native Americans living on the Northern Cheyenne Reservation or adjacent to the reservation in the Ashland area.

Two factors are likely to increase unemployment on the reservation in the future. Recent budget cuts are expected to reduce employment of tribal members by the tribal government and federal agencies. The continuing growth of the Northern Cheyenne labor force will create an additional need for employment opportunities for young people (age 16 and older) if they choose to remain on the reservation.

Table III-16: Energy Industry Employment Characteristics, 1988[1]

Industry	Total Employment	Native Americans	Percent Native Americans
Colstrip Electrical[1] Generating Units 1-4 Montana Power Company	685	133	19%
Rosebud Mine Western Energy Company	382	39	10%
Big Sky Area A Mine Peabody Coal Company	114	10	9%
Spring Creek Mine[1] NERCO	163	8	5%
Decker Mine Decker Coal Company	331	5	2%
Absaloka Mine Westmoreland Resource Company	58	26	45%[2]

Sources: Montana Power Company 1988; Western Energy Company 1988; Peabody Coal Company 1988; NERCO 1988; Decker Coal Company 1988; Westmoreland Resources Inc. 1988.

[1] 1987 data were used when 1988 information was unavailable. This value reflects a hiring contract between the Northern Cheyenne and the Company.
[2] This value reflects a hiring contract between the Crow Indians and the developer.

INCOME

Rosebud County

Total personal income of Rosebud County residents has increased dramatically as a result of energy development (table III-18). From 1970 to 1986, the estimated total annual income of Rosebud County residents increased from $16.6 million to over $120 million, an increase of more than 375 percent after adjusting for inflation. Since the beginning of energy development, the estimated real per capita income of county residents more than tripled (U.S. Bureau of Economic Analysis 1986 and 1988b).

Table III-17: Estimated Labor Force and Employment of Native Americans on and Adjacent to the Northern Cheyenne Reservation for Selected Years

Year	Labor Force	Employed	Unemployed	Unemployment Rate
1970	720	509	211	29.3%
1971	815	557	258	31.7%
1973	928	780	148	15.9%
1975	1,106	766	340	30.7%
1978	1.368	733	635	46.4%
1979	1,414	889	525	37.1%
1981	1,657	957	700	42.2%
1983	1,442	1,057	385	26.7%
1984	1,675	653	1,022	61.0%
1985	1,456	725	731	50.2%
1986	NA	515	NA	NA

Source: Feeney et al. 1986.

Table III-18: Total Personal and Per Capita Income, Rosebud County

Year	Total[1] Personal Income (in $000s)	Per Capita Income
1970	$ 16,635	$ 2,752
1971	17,301	2,847
1973	31,852	4,625
1975	47,398	4,873
1977	48,505	4,570
1979	61,871	6,365
1981	104,602	9,559
1983	141,520	10,458
1984	121,003	9,195
1986	120,701	9,781

Source: U.S. Bureau of Economic Analysis, Regional Economic Information System, 1988b.

[1] Total personal income is summation of all income for all county residents.

In 1986, utility sector employees earned an average income of about $32,000 and mining sector employees averaged about $36,000 (Montana Department of Labor and Industry 1986).

Wage and salary earnings account for the majority of personal income for Rosebud County residents (table III-19). With completion of Colstrip power plant construction in 1984, total annual income for county residents has decreased.

Distribution of income among Rosebud County residents is more uneven than is typical in Montana. The county has higher proportions of individuals and families with both higher and lower incomes than do most counties in the state. The higher than average per capita income in the county is attributable to the high-paying jobs in the energy industry.

Northern Cheyenne Indian Reservation

Comparison of income for Rosebud County residents and Native Americans living on or near the Northern Cheyenne Reservation indicate that the Northern Cheyenne have not experienced economic growth comparable to the overall county economy. In 1986, per capita income for the Northern Cheyenne was $4,280, compared with $9,781 for Rosebud County (U.S. Department of the Interior 1988, U.S. Bureau of Economic Analysis 1988b). High unemployment, generally low earnings for employed Northern Cheyenne, and large family sizes all contribute to the high incidence of poverty on the reservation. The 1980 census showed 46 percent of individual Native Americans and 40 percent of Native American families on the Northern Cheyenne Reservation have incomes below the Federal poverty level.

POPULATION

Rosebud County

Rosebud County has experienced population growth since the initiation of energy development in the county in the late 1960s (table III-20). Population increases have resulted from both in-migration and natural growth (more births than deaths).

Rosebud County population including the Northern Cheyenne Indian Reservation peaked in 1983 at 14,000 during construction of Colstrip Generating Units 3 and 4. Since that time, many power plant construction workers and other temporary workers and their families have moved away. In 1980, three-quarters (7,466 persons) of Rosebud County residents were non-Indians and one-quarter (2,433) were Native Americans (see table III-21). In 1985, the proportion of non-Indians increased slightly to 77 percent of the population of Rosebud County. The 1988 population is estimated to be 11,200 for Rosebud County.

Table III-19: Personal Income by Major Source and Earnings by Major Industry, Rosebud County (in thousands of dollars)

Income by Type	1979	1981	1983	1986
Total Personal Income	$61,871	$104,602	$142,694	$120,701
Non-Farm	57,314	99,785	139,164	116,382
Farm	4,557	4,817	3,530	4,319
Derivation of Total Income				
Net Earnings	46,884	81,683	115,938	109,720
Dividends, Interest Rent	8,221	13,221	114,144	15,096
Transfer Payments	6,776	9,698	12,612	16,845
Components of Earnings				
Wages and Salaries	45,173	99,388	139,659	89,973
Other Labor Income	3,979	8,670	14,469	11,817
Proprietors Income	3,566	2,805	1,855	7,930
Farm	646	720	-1,024	1,509
Non-Farm	2,920	2,085	2,879	6,421
Earnings by Industry				
Farm	4,557	4,817	3,530	4,319
Non-Farm	48,125	106,046	152,453	105,401
Private	40,303	95,657	138,268	88,058
Agriculture, Forest Service	251	292	344	473
Mining	12,490	19,097	19,531	22,029
Construction	6,528	37,496	64,613	4,515
Manufacturing	2,220	1,583	978	409
Transportation, Utilities	5,409	21,662	(D)	(D)
Wholesale Trade	458	472	(D)	728
Retail Trade	3,230	4,147	5,708	5,863
Finance	834	1,052	1,393	2,442
Services	8,883	9,856	13,791	(D)
Government				
Enterprise	7,822	10,889	14,185	17,343
Federal, Civil	2,327	2,684	2,754	2,966
Federal, Military	148	176	316	1,394
State and Local	5,347	7,529	11,115	12,983

Sources: U.S. Bureau of Economic Analysis, Regional Economic Information System 1979-86b; U.S. Bureau of Economic Analysis, Regional Economic Information System, 1988b.

D = Not shown to avoid disclosure of confidential information.

Table III-20: Population Change, Rosebud County, 1950-1988

Year	Population
1950[1]	6,750
1960[1]	6,187
1970[1]	6,032
1976[2]	9,570
1980[1]	9,899
1983[3]	14,000
1986[4]	11,500
1988[5]	11,200

[1]U.S. Department of Commerce, Bureau of the Census, Censuses of Population, 1950, 1960, 1970, 1980.
[2]Montana Department of Community Affairs, Special Census of Rosebud County, Montana, 1976.
[3]Rosebud County Planning Board, estimate for 1983.
[4]Rosebud County Commission, estimate for 1986.
[5]Montana Department of State Lands, estimate for 1988.

Table III-21: Distribution of Indian and Non-Indian Population, Rosebud County and Northern Cheyenne Indian Reservation, 1980 and 1985

	1980		1985	
Area	Persons	Percent of 1980 Population	Persons	Percent of 1985 Population
Rosebud County				
Non-Indian	7,466	75.4%	8,890	77.0%
Indian	2,433	24.6%	2,672	23.0%
TOTAL	9,899	100.0%	11,562	100.0%
Northern Cheyenne Reservation[1]:				
Non-Indian	562	15.3%	565	13.0%
Indian	3,102	84.7%	3,826	87.0%
TOTAL	3,664	100.0%	4,391	100.0%

Source: U.S. Department of Commerce, Bureau of the Census, 1980.

[1]Includes persons living on portions of reservation in Big Horn County.

Forsyth and Colstrip

Forsyth also grew as a result of energy development, increasing from a population of 1,900 in 1970 to 2,500 in 1980, with a peak of 2,950 in 1983. The current population of Forsyth is estimated at 2,500 to 2,700 (L. James, pers. comm., 1986; A. Martens, pers. comm., 1988). In 1988, 63 Peabody employees were living in or near Forsyth. The majority of these people were residents of Rosebud County before accepting work at the mine (Montana Department of State Lands Workers Survey 1986b).

Colstrip is the largest community in Rosebud County. Prior to 1970, Colstrip had a population of less than 200. The Montana Power Company purchased the town in the late 1950s and expanded the townsite in the 1970s and 1980s to house workers at the Colstrip generating units and the Rosebud Coal Mine.

In 1983, during the peak construction of Colstrip Generating Units 3 and 4, Colstrip reached its largest population (8,000). Most of this temporary work force has since left and the population has stabilized at about 4,200 (L. Miller, pers. comm., 1988). In 1988, 34 Big Sky Area A Mine employees lived in or near the town. The majority of these workers moved to Rosebud County from out of state (Montana Department of State Lands Workers Survey 1986b).

Northern Cheyenne Indian Reservation

In 1970, about 2,800 persons were living on the reservation; by 1980, population had increased to 3,500 (U.S. Department of Commerce, Bureau of the Census 1970 and 1980), and in 1986, the population was estimated at 4,400 (Feeney et al. 1986, U.S. Department of the Interior 1988). The population estimates include reservation residents who are non-Indians as well as Indians who are not Northern Cheyenne.

The Northern Cheyenne Reservation is located in both Rosebud and Big Horn counties, but the majority of reservation residents live in Rosebud County. Population growth on the Northern Cheyenne Reservation has resulted primarily from natural population increases, although some in-migration occurred during the expansion of energy development.

The 1980 census reported 2,279 Native Americans living on the reservation in Rosebud County. The majority of the 154 Native Americans living off the reservation in Rosebud County resided in the Ashland area adjacent to the reservation. The census also reported 822 Native Americans living in the Big Horn County portion of the Northern Cheyenne Reservation.

Between 1970 and 1980, the Native American population on the Northern Cheyenne Reservation increased by 30 percent and the non-Indian population on the reservation grew by 26 percent (U.S. Department of Commerce, Bureau of the Census 1980). Rapid growth among the reservation's Indian population has persisted throughout the 1980s (table III-21).

The Lame Deer area is the most populated portion of the reservation. The 1986 population of the Lame Deer District, which includes rural areas outside the town, was estimated at about 2,000 persons.

The town of Ashland is located on the northeastern border of the Northern Cheyenne Reservation. The population has expanded from both in-migration and natural population increases. In 1980, the town population was 240 persons (U.S. Department of Commerce, Bureau of the Census 1980). The population increased during Colstrip construction but has since returned to roughly 1980 levels (M. McRae, pers. comm., 1986).

SOCIAL LIFE

Rosebud County

The residents and communities of southeastern Montana are socially and culturally diverse. Energy development has affected people and communities differently, but, in general, area residents have considerable experience in dealing with the social effects of energy development. Since the late 1960s, coal mine and power plant developments have been influencing the population and the economic and social interrelationships among people in southeastern Montana.

Over one-third of Rosebud County residents have moved into the area since the opening of the coal mines and power plants. In-migrants often have had different backgrounds than persons native to the area. Most employees at the Big Sky Area A Mine lived in Rosebud or Big Horn counties prior to being hired by Peabody. The increased activity in retail and service businesses has contributed to income and employment opportunities for persons working in these sectors. Furthermore, new jobs have afforded some young people the opportunity to find work locally rather than having to leave the area.

Economic and population growth created by energy development also has contributed to increases in local cost of living. In some instances, higher prices for food, personal services, and housing have worsened the economic situation of persons who have not benefitted financially from energy development.

The Rosebud County ranching community has, in general, not benefitted financially from energy development. In some instances, energy development has indirectly increased the costs and difficulty of ranching operations.

Energy industry activities and the major population growth in the Colstrip area have added an urban-industrial element to a previously rural, ranching-oriented area. The ranching community in Rosebud County is comprised mainly of families who have worked the same land for several generations. Families have strong social and economic associations with their land and with each other. Energy development is viewed by some ranchers as changing their way of life and some ranching families have actively opposed the development of power plants and coal mines in Rosebud County.

Forsyth and Colstrip

Forsyth was a well-established community at the time energy development began. Social relationships, common history, and sense of community were already in place. Many of the initial energy industry employees were long-time residents of the Forsyth area. The hiring of local people helped to create a positive attitude among community residents toward mining and aided the acceptance of newcomers to the community by the locals (Meadowlark 1978). Many of the people who moved to Forsyth to seek employment associated with energy development have spent more than a decade in the town and have become well established in the community.

Prior to the 1970s, Colstrip barely existed as a community. Persons moving there, due to power plant construction in the 1980s, created virtually a whole new set of social relationships. In the mid-1980s, the population of Colstrip began to stabilize; today, many people living in the community intend to be long-term residents (L. Miller, pers. comm., 1986 and 1988).

Northern Cheyenne Indian Reservation

The Northern Cheyenne Indians tend to be socially, economically, and politically separate from other residents of southeastern Montana. They have a strong sense of tribal identity, sharing history, language, customs, beliefs, and values distinct from both the non-Indian residents and other non-Northern Cheyenne Indians living in the area. The Northern Cheyenne Reservation affords tribal members the opportunity to preserve and nurture distinctive aspects of the Cheyenne culture.

Tribal members maintain kinship systems and extended family relationships, and some extended families still practice income-sharing. The Northern Cheyenne have traditionally shared a sense of common ownership of the tribal lands.

Tribal members associate closely with the physical and biological characteristics of areas on and near the reservation. Cheyenne beliefs encourage maintenance of harmony between the physical and spiritual environment. The Cheyenne people believe that physical features on and above the earth's surface have animate and spiritual qualities. Certain birds and mammals on and near the reservation have both spiritual and ritual importance to the Cheyenne. To the extent that mining, electrical generation, and other activities associated with energy development have changed the physical and biological environments near the reservation, they have disturbed Cheyenne cultural values (Feeney et al. 1986).

Historically, the preservation of the Cheyenne culture has benefitted from the relative isolation of the reservation. Energy development has accelerated the process of social evolution among Northern Cheyenne, primarily by providing for more contact between tribal members and non-Cheyenne (U.S. Department of the Interior 1988). The number of non-Cheyenne living on and near the reservation has risen. Many school-age Cheyenne children now attend school off the reservation in Colstrip, greatly

increasing experiences of young Cheyenne with the non-Indian culture (J. Buffalo Horn, pers. comm., 1986).

Northern Cheyenne employed at the coal mines and electrical generating plants have benefitted economically from energy development. Energy development, however, has done little to eradicate the social, economic, and public service problems which exist on the reservation. Alcoholism is consistently identified by the Northern Cheyenne as the most serious health and social problems on the reservation. Unemployment, poverty, crime, family problems, inadequate public services, prejudice, and poor communications are identified by tribal members as other important social and economic problems (Feeney et al. 1986, U.S. Department of the Interior, Bureau of Land Management 1988).

The Northern Cheyenne tribal government feels that there have been adverse social and economic impacts on the reservation as a result of the cumulative effects of energy development in the region. Impacts such as lower "real" income, higher cost of living, increased social stress, and increased public service costs have been detrimental. The tribe believes that some adverse effects of energy development could be reduced if the Northern Cheyenne were to share more equally in the employment associated with energy development, and if energy developers were to compensate the tribe for on-reservation service impacts (J. Buffalo Horn, pers. comm., 1986; R. Bailey, pers. comm., 1988).

COMMUNITY SERVICES

Social and community services and facilities in Rosebud County increased during construction of the Colstrip generating units and expansion of the Rosebud and Peabody mines. This growth in services and facilities was financed largely by State and Federal impact assistance and by property taxes from the generating units and the Rosebud and Peabody mines. The Northern Cheyenne Indian Reservation received relatively little impact assistance, but benefitted from a mitigation agreement with The Montana Power Company that provided funds for improved reservation services and facilities. Most of the funding under this agreement terminated in 1985. The reservation became eligible in 1984 to receive Montana Coal Board impact assistance and has received four grants totaling about $554,000.

Law Enforcement

The Rosebud County Sheriff's Department provides law enforcement for the communities of Forsyth, Colstrip, Ashland, and surrounding areas. The Sheriff's Department, headquartered in Colstrip, employs six deputies. They maintain three patrol cars and a four-cell detention facility. The sheriff's low-frequency band radio system is also used for emergency medical service and fire protection. The sheriff considers his staff and equipment adequate to serve the present population (G. Makin, pers. comm., 1988).

Rosebud County experienced 155 Part I crimes in 1986, resulting in a crime rate of 1,185 crimes per 100,000 residents. Part I crimes include

homicide, rape, robbery, aggravated assault, burglary, larceny and theft, and motor vehicle theft. The state-wide average crime rate per 100,000 population for 1986 was 4,226.9, nearly four times the Rosebud County rate.

Law enforcement services on the reservation are provided by the tribe and federal, state, and county agencies. The Northern Cheyenne police have the primary responsibility for maintaining law and order. Major felonies and crimes involving non-Indians are handled by the U.S. Attorney's Office and the Rosebud County Sheriff's Office, respectively.

Data on crimes committed on the reservation are not available from police records for recent periods. In 1984, 69 felony cases were tried in tribal court and in 1985, 33 felony cases were tried.

Between 1983 and 1986, the tribe's annual budget for law enforcement dropped from $441,300 to $57,000. Police staffing also declined from a high of 18 in 1984 to 10 in 1987 as a result of reductions in federal and tribal funds. The Tribal Police Department is reported to suffer from poor morale, high employee turnover, and a low level of professional training (Feeney et al. 1986).

Fire Protection

Forsyth and Colstrip are served by volunteer fire departments numbering 16 and 22 persons, respectively. The Forsyth Fire Department is equipped with four 1,000-gallon pump trucks, and Colstrip has five vehicles including two 1,000-gallon pumps, a 2,000-gallon tanker, a 1,500-gallon tanker, and an equipment van.

On the reservation, firefighting equipment consists of a 1,000-gallon tanker and a pumper truck located in Lame Deer and a 300-gallon pumper stationed in Busby. Although there is no organized or trained structural firefighting crew, fires are fought by Bureau of Indian Affairs (BIA) employees on a volunteer basis.

Forsyth has a class 5 insurance rating, Colstrip a class 7 rating, and the reservation a class 9 rating. Large portions of Rosebud County have a class 10 rating, meaning that the Insurance Services Office of Montana considers them unprotected against fire.

Wastewater Treatment and Water Supply

Forsyth and Colstrip both have oxidation-ditch wastewater treatment facilities. The systems are designed for populations of 5,000 and 7,500, respectively (Montana Department of State Lands 1985).

Each of the five reservation districts is served by community wastewater lagoons which were designed to meet the Federal Indian Health Service (IHS) standards. The Ashland lagoons, however, have leakage problems and there are occasional operation problems with the Busby and Birney systems. The Lame Deer system is now operating at maximum capacity (U.S. Department of the

Interior 1988). The IHS provides septic tank installation free for Native Americans living on rural homesites. There are currently 333 septic systems on the reservation (Feeney et al. 1986).

The Yellowstone River provides the primary domestic water source for Forsyth and Colstrip. The Forsyth system has a capacity of 3.5 million gallons per day (mgpd) and elevated storage of 3.5 million gallons (Montana Department of State Lands 1983). The Colstrip system has a capacity of 5.7 mgpd and uses a gravity-feed distribution system (Montana Department of State Lands 1985). The five reservation districts are served by community water wells, and 290 reservation homesites have their own water wells (Feeney et al. 1986).

Solid Waste

Rosebud County operates a 25-acre landfill near Colstrip. Forsyth and Colstrip use separate private contractors for waste collection and transport to the landfill. The landfill is also utilized by Treasure County (which borders Rosebud County on the west) and by four of the five reservation districts. The capacity of the landfill and number of collection contractors are considered adequate (M. Young, pers. comm., 1988), except for Lame Deer.

Social Welfare

The Rosebud County Department of Public Welfare is headquartered in Forsyth and has community outreach offices in Colstrip and Lame Deer. The Forsyth office has a staff of four professionals and offers the full range of services and programs available in every Montana county. The Colstrip office employs one staff member and offers only social and child protection services.

Six tribal departments or programs administer a number of Federal and State contracts for social services on the reservation. The Tribal Social Service Office serves the largest number of clients, with programs funded jointly by Federal contracts and the tribe. The current staff of three professionals in this office is inadequate to address existing caseloads.

The County Welfare Office in Lame Deer lost its only professional staff member in November of 1985, leaving one secretary and two eligibility technicians (U.S. Department of the Interior 1988). At present, tribal social service workers are able to respond to problems on an emergency intervention basis only (Feeney et al. 1986).

Medical Services

Rosebud County is served by Rosebud Community Health Center in Forsyth. Patients requiring major surgery or intensive care are often treated in Billings or Miles City, and there is a long-standing pattern of residents going out of the county for hospital care (Montana Department of State Lands

1983). The hospital has 20 licensed beds and a staff of 68 full-time equivalent employees. Since 1983, the hospital has averaged a 28 percent occupancy rate (Y. Armstrong, pers. comm., 1988).

The Colstrip Medical Clinic, which provides outpatient medical services, is staffed by one full-time doctor and is visited on an as-needed basis by various specialists from Miles City. Emergency transportation to other medical facilities is provided by the four ambulances and 11 volunteers of the Colstrip Emergency Medical Service and by the air ambulance service of Saint Vincent Hospital in Billings.

An Indian Health Service (IHS) clinic in Lame Deer provides outpatient care to all eligible Native American residents of Rosebud and Big Horn counties. Built in 1976, the clinic is staffed by four full-time physicians, a dentist, and a part-time optometrist. Other specialists visit the clinic regularly. The clinic reported over 36,000 outpatient visits in 1985--an increase of 16 percent from 1984 (Feeney et al. 1986).

Education

The project area population is served by public schools in Forsyth, Colstrip, Lame Deer, and Ashland. The Forsyth School District operates an elementary school, a middle school, and a high school. In the spring of 1986, the elementary school had an enrollment of 366 students with an average class size of 21 (M. Truscott, pers. comm., 1986). Accreditation standards for class size can be used to determine the percent of capacity represented by a school's student load. Current accreditation standards limit classes to 24 students in kindergarten, 26 in grades 1 and 2, 28 in grades 3 and 4, and 30 in grades 5 through 12 (Montana Board of Public Education 1983).

In May 1986, the Forsyth middle school had an enrollment of 153 and an average class size of 20. High school enrollment was 216 students with an average class size of 12 (M. Truscott, pers. comm., 1986).

The Colstrip School District operates two elementary schools, a middle school, and a high school. Elementary enrollment totaled 649 in 1985, and average class sizes were 18 and 20 at the two schools. The middle school serves 292 and has an average class size of 25. Colstrip High School's 1984 enrollment was 429 students with 26 students in an average class. Overall, the 1985 Colstrip school district enrollment was 164 students less than in 1982-83, when construction of Colstrip Generating Units 3 and 4 was at its peak (Montana Department of State Lands 1985).

Schools serving reservation residents include the Lame Deer Elementary School, the Busby School, St. Labre School, and public schools in Colstrip, Ashland, and Hardin. The Lame Deer Elementary School serves 362 students in grades kindergarten through 8. Enrollment declined from 454 in 1984, largely the result of transfers to Colstrip public schools (Feeney et al. 1986). The BIA-funded Busby School serves students in grades kindergarten through 12; it operated as a day and boarding school until 1984, when the high school was closed because of inadequate facilities, declining enrollment, and a corresponding decline in Federal funding. The school regained its

accreditation and offered a full high school curriculum in 1987. Eighteen percent of the 264 Northern Cheyenne high school students attend the Busby Tribal School. The other 82 percent of high school students in the Busby area are transported by bus to Colstrip, Hardin, and St. Labre schools, each of which is over 40 miles away. Attendance of Northern Cheyenne students in off-reservation schools is problematic because these schools offer little exposure to Native American culture or language. The long daily commutes over poor roads tend to discourage student or parental involvement in extracurricular activities associated with the school environment (U.S. Department of the Interior 1988).

The St. Labre School is a Catholic parochial school serving about 450 students in grades kindergarten through 12. Northern Cheyenne students make up about 24 percent (30 students) of school enrollment at Ashland Public Elementary School. Approximately 40 students from the Busby-Kirkby area of the reservation attend school in Hardin (Feeney et al. 1986).

Dull Knife Memorial College at Lame Deer, which had 125 students in 1985, offers additional educational programs, including associate degrees and vocational studies. The BIA administers an adult vocational program and the U.S. Department of Health and Human Services and the tribe jointly fund an extensive Head Start program for pre-schoolers.

<u>Housing</u>

Rosebud County housing units approximately doubled in number between 1970 and 1980. Mobile homes, which accounted for about 60 percent of this increase, make up over one-third of the housing in the county. Two-thirds of all county housing is owner-occupied (Montana Department of State Lands 1985).

The growth in the number of housing units in Forsyth was the result of steady market demand for housing and was not strongly affected by changing levels of construction employment (Montana Department of State Lands 1985). The 1980 census reported 1,242 year-round housing units, 23 percent of which were mobile homes and 62 percent of which were single-family, detached dwellings.

The increase in the number of housing units in Colstrip was attributable to Sunlight Development Company's financing or construction of 960 dwellings. Total housing units in 1983 numbered about 2,700. Completion of the generating units greatly reduced the demand for housing, and Sunlight Development Company has been selling mobile homes and having them moved from Colstrip. A mid-1984 housing count indicated 1,438 occupied houses and 90 occupied recreational vehicles.

Despite several large housing projects sponsored by the U.S. Department of Housing and Urban Development (HUD), there is still a shortage of both rental and purchase units on the Northern Cheyenne Indian Reservation. As of December 1985, there were approximately 1,139 permanent housing units on the reservation, including 641 HUD homes, 126 homes for government agency workers, 345 private homes, and 27 tribal staff homes. Of these, 149 were in

substandard condition (Feeney et al. 1986). Temporary accommodations are available in four local trailer courts.

The Northern Cheyenne Housing Authority now has approximately 200 families on its low-rent housing waiting list and 100 families on its homes-to-purchase waiting list. Actual demand is thought to be higher. The reservation was authorized funds for 80 new HUD homes in the summer of 1987. Many Native Americans that seek housing on the reservation move in with family or friends.

LAND USE

The dominant land use within the proposed Big Sky Mine Area B permit area is livestock grazing on rangeland. Approximately 3,500 acres of the proposed 5,435-acre permit area are available for grazing. Steep terrain, limited access, and excessive distance to stock water limit grazing on the remaining acreage (1,935). Several fields in the proposed permit area that once supported dryland crops or hay are now used as dryland pasture. One field is currently used for summer-fallowed dryland wheat. Although there are agricultural areas in the Lee Coulee drainage, there is no prime farm land.

Four ranch operators presently lease grazing rights from the surface owners, Peabody Coal Company and Burlington Northern. The grazing allotments are divided by fencelines which generally follow old homestead boundaries. Stock water in the proposed permit area is generally well distributed; it includes six wells and 10 stock ponds or reservoirs. All of the ponds are dry by mid-summer except three which lie within the intermittent stretch of Lee Coulee.

Three of the four grazing lessees utilize their allotments in spring and/or summer. One operator grazes his cattle on the allotment in the winter. Actual stocking rates used by the four operators range from .04 to .055 animal unit months (AUMs) per acre, or 18 to 25 acres per cow/calf unit. The SCS recommended stocking rates for various sites in the permit area in mid-good condition range from .05 AUMs/acre for the shale and breaks areas to 1.0 AUMs/acre for the subirrigated reaches of Lee Coulee and Fossil Fork and 1.1 AUMs/acre for the dryland pasture. Range condition in the permit area averages 53 percent (low-good) and varies from 35 percent (fair) to 82 percent (excellent).

One field located outside the disturbance area in Section 32 is presently used for dryland winter wheat production. Several decades ago, this field received intermittent flood irrigation from a water diversion structure and gravity-fed irrigation ditch system located upstream in Lee Coulee. This system was abandoned in the 1950s. The 10-year average for wheat production in this field is estimated to be 30 to 32 bushels per acre (Don Bailey <u>in</u> Peabody Coal Company 1987a, Volume 7).

The proposed mining operation is compatible with existing state and local land use plans and programs. In April of 1979, Rosebud County adopted a county comprehensive plan. The plan provides land use plans for the

communities of Forsyth, Colstrip, Ashland, and Birney. There are no local laws or ordinances regulating land use in the proposed permit area. The BLM Powder River Resource Management Plan was completed in March of 1985, and addresses mining of lands in the Lee Coulee area. There are no fragile lands nor critical, natural resource lands in the proposed disturbance area that provide substantial food or fiber products, or water supplies.

TRANSPORTATION

The transportation network in Rosebud County consists of secondary, primary, and interstate highways, a railroad mainline and spur, and a county airport east of Forsyth. Commercial air transportation is available in Billings, Miles City, and Sheridan, Wyoming.

Highways

A 2.3-mile access road connects the Big Sky Area A Mine to State Highway 39. State Highway 39 connects Colstrip to Interstate 94 West of Forsyth and also connects to State Highway 37 to the south. The average daily vehicle count on State Highway 39 increased more than 500 percent between 1967 and 1981 and peaked at 1,750 cars per day in 1982. Eighty percent of this increase was attributable to construction of the Colstrip generating units. The remaining 20 percent was attributable to increase in mining activity (Montana Department of State Lands 1983). Since January of 1984, traffic between Forsyth and Colstrip has decreased 63 percent to about 1,100 cars per day, probably due to the completion of Colstrip Generating Unit 4 (Montana Department of Highways 1987).

In 1983, State Highway 39 was widened, resurfaced, and realigned along certain stretches north of the Northern Cheyenne Reservation border. US Highway 212 is the east/west route across the reservation and is the major local and commercial transportation route. Traffic volume on US 212 averages about 1,500 vehicles per day (Montana Department of Highways 1987). The on-reservation stretches of both highways (US 212 and State Highway 39), although under state jurisdiction, generally have very low sufficiency ratings based on a combination of road conditions, capacity, and safety. Fatality rates on State Highway 39 are much higher than on most off-reservation roads. Highway safety is an area of critical concern for the Northern Cheyenne because of the large number of school buses that transport students on the reservation daily.

Railroads

A 7.5-mile rail spur connects the Big Sky Area A Mine to the Burlington Northern tracks near Colstrip. These tracks run 33 miles to the north where they join the east-west mainline along the Yellowstone River. The Big Sky Mine rail spur crosses State Highway 39 several miles east of the mine. The six 104-car unit trains which utilize the crossing in an average week cause delays to road traffic. The Burlington Northern tracks are separated from State Highway 39 by several overpasses between Colstrip and the mainline.

RECREATION

Both developed and undeveloped recreation resources are present within the study area. While developed parks and recreation facilities are found primarily at Colstrip and Forsyth, other opportunities for dispersed recreation also are present throughout the study area.

Colstrip recreation facilities are managed by the Colstrip Park and Recreation District. The district was formed in 1987 and includes a 51-acre park system. Facilities at Stillwater Park, an outdoor recreation complex, include one baseball and two softball fields, a soccer field, a basketball court, and playground. Other facilities at the Colstrip Community Center include two handball and racquetball courts, a basketball court, and a weight and exercise room. The swimming pool currently is used to capacity, as are the playing fields at Stillwater Park. Neighborhood parks around Colstrip provide additional basketball courts, playing fields, a wading pool for children, and an outdoor skating rink.

Castle Rock Lake, on the west edge of Colstrip, provides facilities for picnicking, swimming, and fishing. Boats without internal combustion engines also are allowed. This 152-acre, man-made lake is used by The Montana Power Company to provide make-up water for the Colstrip generating units and for the Colstrip public water supply. Planned recreational improvements for the district include a golf course, additional ball fields, and an improved picnic area and restroom facilities at Castle Rock Lake (L. Miller, pers. comm., 1988).

Forsyth's park system consists of six parcels, four of which are developed. The largest park, Riverside Park, covers approximately six acres. Existing recreation facilities include four softball fields, three skating rinks, eight tennis courts, and an indoor pool. A running track is shared in a cooperative agreement with the school district. Recent improvements at Riverside Park include a new grandstand and night lighting. Other neighborhood parks have added playground equipment and improved picnic facilities (J. Foran, pers. comm., 1988). The Rosebud County fairgrounds are located east of town. A nine-hole golf course west of town is owned by the city and leased to the Forsyth Country Club.

East and west of Forsyth, DFWP manages the Rosebud East and West Fishing Access Sites. These areas provide camping, fishing, and boat-launch facilities. Improved parking and boat-launch facilities are planned for the summer of 1988. The Rosebud East Unit is currently exceeding capacity for both day use and fishing use (D. Monger, pers. comm., 1988). Other DFWP recreation areas along the Yellowstone River include Far West Fishing Access Site approximately 10 miles east of Forsyth and Amelia Island Fishing Access Site near Hysham.

South of the project area, the Rosebud Battlefield State Monument and Tongue River Reservoir provide additional recreational opportunities. The Tongue River Reservoir, approximately 60 miles south of Colstrip, provides fishing, boating, and camping opportunities in a largely undeveloped setting.

Below the reservoir, the Tongue River offers opportunities for fishing, boating, and wildlife observation. The 30-mile river stretch from Birney to Ashland supports a smallmouth bass fishery, but access is limited by the Northern Cheyenne Tribe and by private landowners.

The Ashland District of the Custer National Forest, located southeast of the project area, has three campsites--Cow Creek, Red Shale, and Holiday Springs. Picnic facilities are found at Poker Jim and a recreational cabin is available year-round. The national forest also offers numerous opportunities for dispersed recreation such as hunting, hiking, and horseback riding on approximately 498,000 acres in the district. Fishing opportunities are limited (R. Hayman, pers. comm., 1988). Public land managed by the BLM is also available for dispersed recreation.

Various recreational resources are present on the Northern Cheyenne Reservation. Use limitations for non-tribal members and non-Indians vary by activity (Feeney et al. 1986). Most developed recreational facilities on the reservation are located in Lame Deer, including the tribal gymnasium, Cheyenne social club, swimming pool, two baseball fields, and handgame building. Of these facilities, the tribal gymnasium is probably most heavily used, with activities such as basketball games, head-start programs, pow-wows, and reservation meetings. Non-member use and participation depends on the activity.

Dispersed outdoor activities include hunting, fishing, hiking, picnicking, horseback riding, and plant and berry gathering. Unrestricted year-round hunting is allowed on the reservation for enrolled tribal members, but hunting by non-members and non-Indians is not permitted. Although harvest data are unavailable for the reservation, wildlife surveys conducted annually since the late 1970s indicate a steady decrease in game. Fishing opportunities are limited to a few ponds that are occasionally stocked. Tribal members do not need permits. No fishing permits have been issued to non-members since 1981 because of limited pond stocking. Other types of dispersed recreation are generally unregulated by the tribe (U.S. Department of the Interior 1988).

Developed outdoor recreation areas on the reservation are Crazy Head Springs and Lost Leg Lake for fishing, picnicking, and camping, and Greenleaf, Red Nose, Parker, and LaFevre ponds for fishing. Morning Star Lookout is a scenic overlook. Use figures are not available for these areas. A 1981 survey indicated Crazy Head Springs is the most frequently used and that reservation residents are the main users.

Dispersed recreation constitutes the major recreational activity in the study area. A survey conducted by Western Analysis (1982) indicated over 75 percent of the adults surveyed fish, hunt, camp, or picnic. Hunting activity centers on fall big game hunting and spring and fall turkey hunting.

No developed recreational facilities are located in the proposed mining area. Any dispersed recreation currently occurring in the area, such as hunting or horseback riding, is with the permission of the landowner or leaseholder.

CULTURAL RESOURCES

The cultural resources of the proposed Big Sky Mine Area B is classified within the Northwestern Plains chronological framework (Mulloy 1958, Reeves 1969, Frison 1978). The pine breaks ecosystems which typify the study area have been intermittently used by early peoples over the last 10,000 years. However, available archaeological evidence indicates that the area was most intensively used between 1000 B.C. to 1800 A.D. (Peabody Coal Company 1987a).

Early peoples attracted to the area sought a variety of animal and plant resources, abundant fuel, raw material for tool making, and shelter in stands of pine and sandstone outcrops. Only the most recent sites can be attributed to particular ethnic groups such as the Crow and Northern Cheyenne tribes. While these tribes dominated the use of the Yellowstone, Tongue, and Powder river areas of southeastern Montana in prehistoric and early historic times, Native American use of the areas changed after the battle of the Little Big Horn and the establishment of the Montana Indian reservations (Peabody Coal Company 1987a).

Non-Indians began to homestead and raise cattle in the area during the late 1870s and 1880s, marking the beginning of Euroamerican settlement in this part of Montana (Peabody Coal Company 1987a).

The history of the proposed mine area was recorded during a survey of 18 historic sites, 24 archaeological sites, and 10 sites containing evidence of both historic and prehistoric use. These sites include homesteads, campsites, workshops, and rock art locations. Of these sites, eight have been determined eligible for listing in the National Register of Historic Places. One additional site requires further testing to determine its eligibility for listing. These sites are listed in table III-22.

Although some of the area's geologic formations contain vertebrate fossils of scientific value in other parts of Montana, a detailed survey of the study area did not reveal evidence of important fossil remains.

AESTHETICS

The project area is characterized by broad, rolling uplands, low hills covered with ponderosa pine and juniper, valley bottoms with cropland and hayfields, and scattered outcrops of sandstone, shale, and clinker. These landforms and vegetation patterns combine to form a visually diverse and aesthetically pleasing landscape.

The proposed mining area is within the Lee Coulee drainage approximately 6 miles south of Colstrip. The grass- and sagebrush-covered valley floor and adjoining pine-covered ridges of Lee Coulee combine to form a visual entity separate from adjacent coulees. Rosebud Creek, approximately 3 miles to the southeast of the disturbance area, is the nearest permanent water source. Evidence of man in Lee Coulee is limited to old homesteads and agricultural features such as fences, windmills, roads, and trails.

Table III-22: Eligible Historical and Archaeological Sites Affected by the Peabody Big Sky Mine - Area B

Site Number	Site Type(s)	Eligibility Criteria[1]	Type of Disturbance	Period of Disturbance (Year)
24RB1145	Prehistoric camp/workshop	d	Active mine disturbance	2000-2004
24RB1150	Procellainte workshop, historic petroglyph	d	Associated mine disturbance	2005-2009
24RB1153	Petroglyph	c, d	Associated mine disturbance	2005-2009
24RB1164	Petroglyph, prehistoric camp	d	Active mine disturbance	1994
24RB1171	Petroglyph	c, possibly d	Active mine disturbance	1993
24RB1176	Petroglyph, prehistoric camp, lithic scatter	c, d	Active mine disturbance	1992
24RB1181	Petroglyph, prehistoric camp, lithic scatter	c, d	Active mine disturbance	1990
24RB1185	Rock shelter	d	Adjacent to limit of disturbance, possible blast effects or vandalism	DNA
24RB1163	Lithic scatter, historic	To be determined following additional field work	Active mine disturbance	1994

[1]National Register eligibility criteria important for this project are: c. Sites that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a mater, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction. d. Sites that have yielded, or may be likely to yield, information important in prehistory or history.

Between the project area and Colstrip, the rural setting has been replaced by strip mining activities, contributing to a developed, industrial atmosphere. Mining activities for Area A of the Big Sky Mine are currently underway in Miller Coulee, the next drainage to the north, and at Western Energy Company's Rosebud Mine near Colstrip. The proposed mining area is located in the upper portion of Lee Coulee and is more than 3 miles from the nearest highway--State Highway 39. Mining activity would not be visible from this road.

The project area is located in a sparsely populated area. Existing sounds in the project area are limited largely to livestock, occasional vehicles, wildlife, and the elements. There are no residences within the proposed permit area or within 1 mile of the permit boundary.

CHAPTER IV:
IMPACTS OF THE PROJECT

METHODS AND STUDY AREAS

To better understand the analyses in this EIS, a brief description of the study methods and areas of concern for each discipline follows.

Air Quality

Total suspended particulate (TSP) monitoring was performed using a high-volume sampler at the upper (northwest) end of Lee Coulee in Section 23, T1N, R40E. These data are considered representative of the proposed permit area. TSP data from Peabody Coal Company's Area A and Western Energy Company's air monitoring networks are representative of the general Colstrip area.

Air quality impacts were estimated using the Climatological Dispersion Model developed by the EPA. Meteorological data used in this computer model were gathered at the Area B monitoring site previously described. Meteorological parameters included wind speed, wind direction, and temperature.

Geology

The study area encompasses the Rosebud Creek drainage, but focuses on the Lee Coulee drainage.

Hydrology

The study area includes the Rosebud Creek drainage and portions of the East Fork of Armells Creek drainage where proposed Western Energy Company's and Peabody's mining activities could affect well drawdowns and ground water in the Rosebud Creek drainage. Currently, both Western Energy Company's Rosebud Mine and Peabody's Big Sky Mine Area A could influence ground water characteristics in aquifers discharging to Armells Creek and Rosebud Creek.

The Rosebud Mine (Areas A, B, and C) are located in the Armells Creek drainage whereas Areas D and E are located in the drainages of both Armells and Rosebud creeks. Both ground and surface water from the Big Sky Mine Area A discharge to Rosebud Creek.

Well drawdowns were calculated as shown in Peabody Coal Company's application (Peabody Coal Company 1987a). Drawdowns from Peabody Coal Company's proposed mine were compared with drawdowns predicted for Western Energy Company's mine (Montana Department of State Lands and U.S. Office of Surface Mining 1983). Well drawdowns from these two proposed mines could be additive if the Western Energy Company and Peabody Coal Company mines operate in close proximity.

Water discharging from the spoils in Western Energy Company's proposed Rosebud Area B Mine was assumed to flow into Lee Coulee if the spoils were located within the Lee Coulee drainage.

For the analysis of cumulative impacts to surface water quality of Rosebud Creek, a computer model developed by the USGS (Ferreira 1984) was updated. TDS concentrations in Rosebud Creek were simulated using a mass balance of streamflow as related to dissolved solids. Changes in TDS due to both irrigation and mining were examined in the model. The model assumes that, at some future time, degraded water from coal mine spoils in the tributaries of Rosebud Creek would reach Rosebud Creek. The study area encompasses the Rosebud Creek drainage. Areas within the Rosebud Creek drainage that have been mined or have mining permits pending were compiled on a 1:24,000 scale map. Mined areas were measured and assigned to segments of Rosebud Creek as required by the USGS model.

Old spoils from Northern Pacific's past mining occur on the drainage divide between Rosebud Creek and the East Fork Armells Creek. The ground water drainage divide was drawn as depicted in the original studies for the Colstrip study (Westinghouse 1973).

TDS for water emanating from the spoils were assigned a value of 4,245 mg/l, the average quality of water emanating from spoils in Peabody Coal Company's Area A. This is an overestimate of TDS when compared to water quality from Western Energy Company's mine and the old Northern Pacific spoils.

Soils

Peabody utilized an Order 3 Soil Survey conducted by the Soil Conservation Service (SCS) for Rosebud County as the basis for the survey of Area B. Soil studies conducted work by Montana State University and a database developed for the Montco Mine were also reviewed for interpretive purposes.

Following a reconnaissance of the area, a high intensity soil survey was conducted at a scale of 1" = 400'. Over 220 auger holes and backhoe pits were dug to observe, describe, and sample the area soils. These data (including soil analyses) were then used to determine representative soils, salvage soil amounts, soil chemical characteristics, and complete soil textural characteristics. Nineteen soil series were mapped, sampled, and described for Area B.

Aquatic Life

Peabody biologists sampled aquatic macroinvertebrates in Lee Coulee during June 18-20, 1985 (Peabody Coal Company 1987a, Volume 8). Only three ponds in Lee Coulee were large enough to accommodate standard sampling methods. The biologists collected bottom-dwelling macroinvertebrates with an Echman dredge for population density estimates. They surveyed other aquatic organisms by drawing a net along the bottom and through vegetation. Prominent aquatic plant species were identified. In 1975 and 1976, DFWP used electrofishing to survey Rosebud Creek (Elser and Schreiber 1978). Baril et al. (1978) used various methods to study the macroinvertebrates of Rosebud Creek.

Vegetation

The vegetation study covered 7,095 acres including the area that would be mined under the proposed approvals. Canopy cover, plant frequency, and production were measured along transects that were established at various locations in the study area. Tree and shrub densities also were recorded.

Wildlife

The proposed permit area is within the Big Sky Mine wildlife study area. Montana Highway 39 serves as the study area's eastern boundary while Richard Coulee and East Fork Armells Creek roughly define the remaining boundaries. The 30-square-mile study area established in 1973 was enlarged to 34 square miles in 1981 and 49 square miles in 1984.

Biologists for Peabody Coal Company began surveying wildlife in the study area in 1973. Observers traveled aerial and ground routes and recorded sightings of animals. The time spent on aerial surveys ranged from 22.5 hours in 1982 to 6.5 hours in 1984. Although company personnel continue to record incidental observations, systematic ground surveys were discontinued in 1984. Each year, biologists search for birds of prey nests and monitor sharp-tailed grouse dancing grounds. Small mammal traplines and bird count transects supply additional information. Wildlife habitat types and special features have been mapped.

Surveys by DFWP provide additional information on mule deer and pronghorn distributions. Deer range was based on aerial surveys conducted during the winters of 1976-77 and 1978-79 (Swenson 1980). BLM used DFWP reports to delineate pronghorn range (Gorges 1986).

A cumulative impact analysis area that might be visited by mule deer using the proposed permit area is shown in figure IV-1. The boundaries of the cumulative area were based on information from DFWP (Knapp 1986). This area includes all additional range that could be visited by mule deer that use the proposed permit area.

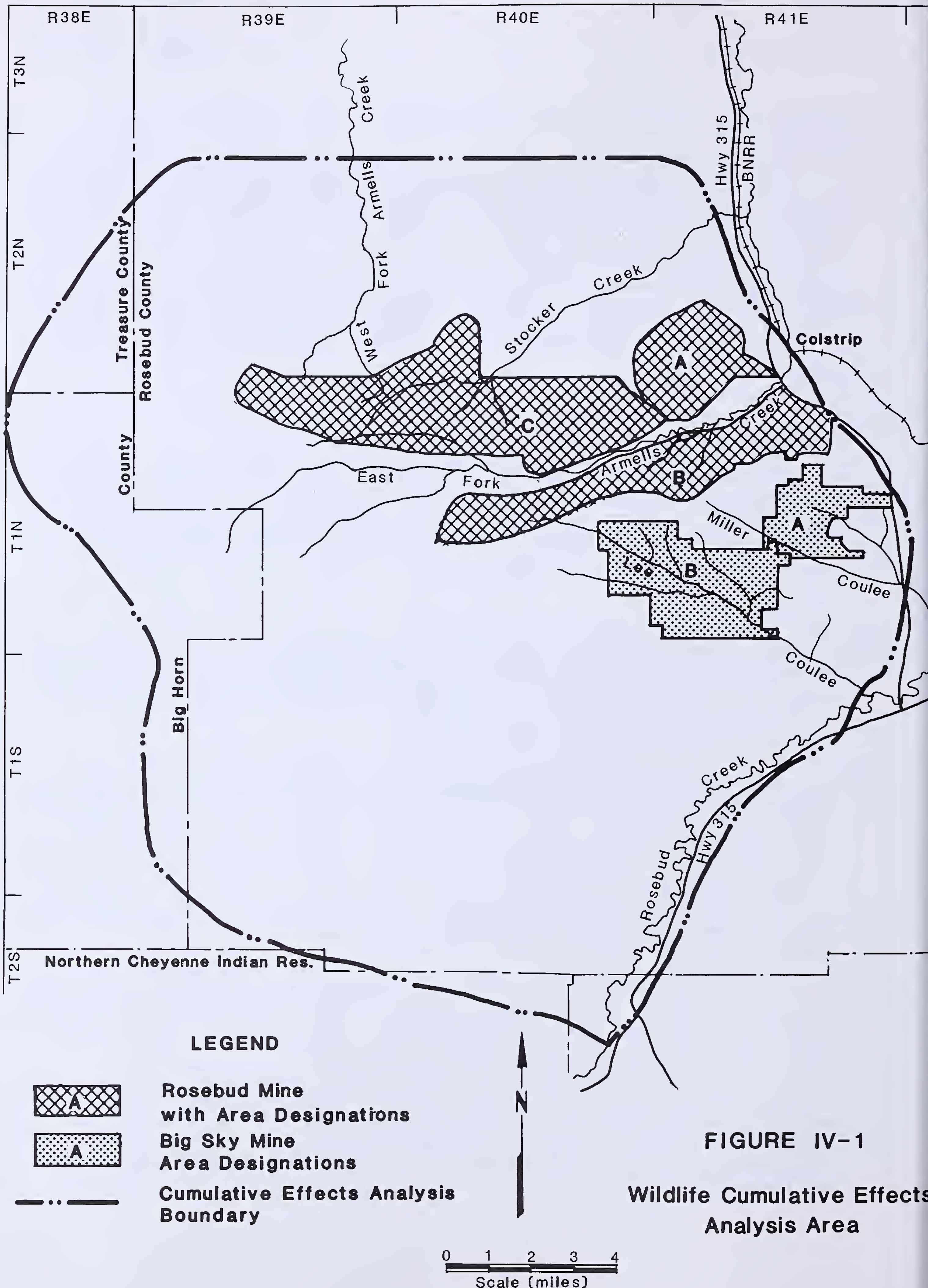


FIGURE IV-1

Wildlife Cumulative Effects Analysis Area

Employment and Income

The economic study area includes Rosebud County, selected communities in Rosebud County, and the Northern Cheyenne Indian Reservation. A model was developed to project future economic and population characteristics of Rosebud County. The model identifies existing relationships between basic and non-basic employment levels and the non-Indian population of the county. The model assumes that these relationships would remain similar throughout the duration of the project study period.

The economic impacts of the Big Sky Mine were projected using assumptions regarding mine employment and wages. First, the model projected future basic and non-basic income accruing to county residents. Employment in the county was then derived based on the historic relationship between income and employment in the various economic sectors. Population projections were made by applying a ratio of the non-Indian population in the county to the sum of the employment projections.

Population projections for Native Americans are based on research conducted by Feeney et al. (1986) and the Bureau of Land Management (1988). The methodology assumes that recent rates of natural population increase among Northern Cheyenne will continue; that the Reservation would experience net in-migration during periods of major economic growth; and that net out-migration will occur when economic conditions remain static or decline. Migration rates are based on patterns which occurred in the 1970s and early 1980s.

Population and Social Life

The social impact study area for the proposed expansion of Peabody Coal Company's Big Sky Mine is identified as Rosebud County, selected communities in Rosebud County, and the Northern Cheyenne Indian Reservation. The definition of the impact area is based upon the settlement patterns of existing employees at the Big Sky Area A Mine.

Cultural Resources

Historical Research Associates (HRA) was contracted by Peabody Coal Company to perform cultural and paleontological resource investigations within and adjacent to the proposed Big Sky Mine Area B expansion. An intensive inventory was conducted on 5,140 acres in and around the disturbance area to determine the presence of historical, archaeological, and paleontological resources. Approximately 500 additional acres within a 500-foot-wide buffer zone adjacent to the permit area boundary also were examined. A lower intensity though systematic reconnaissance inventory was conducted up to 1 mile out from the permit boundary to identify standing structures and sandstone outcrops which could be subject to impacts from

blasting. Cultural resource survey work was denied by landowners in Sections 1, 2, and 3 (T15, R41E) and Sections 26 and 27 (T1N, R40E). These areas were outside the permit boundary.

Historical and archaeological surveys were conducted considering past surveys done for Western Energy Company (Fredlund 1973, Fredlund and Fredlund 1974, Fredlund 1980a, Fredlund 1980b) and for the Peabody Coal Big Sky Mine Area A (Munson and Munson 1980). Additional literature and site records were consulted to help determine the presence of and potential for historic sites (Hanchette and Deaver 1982, Montana Department of State Lands 1983, Fredlund 1973).

Results were summarized in a report submitted as part of Peabody's application. A review of this report was conducted by personnel from BLM, DSL, OSMRE, and SHPO. In August 1986, personnel from these agencies accompanied HRA and Peabody on a field trip to the study area to inspect, review, and evaluate the significance of and mitigation plans for the numerous archaeological sites located during the baseline survey. Based on these reviews and field work, joint recommendations on eligibility of sites for listing in the National Register of Historic Places were formulated. Additional survey work is to be conducted during the 1988 field season to determine questions of eligibility for one site.

Aesthetics

The study area, generally extending from Roundup to Broadus and including the south half of Rosebud County, is part of the Pine Parklands region (Crowley 1972). This area provided the regional context for aesthetic descriptions and impact analysis. The U.S. Department of Agriculture, Forest Service (1974) and U.S. Department of the Interior, Bureau of Land Management (1980) visual resource management systems provided the framework for assessing visual impacts. A site visit to Lee Coulee to view and record project area conditions supplemented this information.

AIR QUALITY

Impacts Common to Alternatives 1, 2, and 3

The greatest impact to air quality would result from fugitive dust (particulate) generated by mining activities. Overburden handling and haul roads are the most important sources. Table IV-1 lists the particulate emission sources, control practices to be used, and emission estimates. Particulate emissions prior to the application of controls are estimated at 1,087.1 tons per year, while controlled emissions are estimated at 445.8 tons per year. Emission estimates were based on values projected for 1996. The emission factors which were used in the calculations are from the DHES Air Quality Bureau's recommended list of coal mining emission factors (see Appendix).

Table IV-1: Particulate Emission Inventory for the Proposed Big Sky Area B Mine

Activity	Uncontrolled Emissions (tons/year)	Controls	Percent Control	Controlled Emissions (tons/year)
Scraper Emissions	12.0		0	12.0
Overburden Drilling	3.6		0	3.6
Overburden Blasting	1.1	Sequential Detonation	0	1.1
Overburden Removal	160.0	Minimize Fall Distance	0	160.0
Coal Drilling	1.3		0	1.3
Coal Blasting	0.8	Sequential Detonation	0	0.8
Coal Removal	3.0	Minimize Fall Distance	0	3.0
Haul Roads	321.4	Chemical Stabilization, Water	80	64.2
Coal Dumping	18.1	Minimize Fall Distance	0	18.1
Coal Storage	29.1		0	29.1
Coal Crushing	113.8	Water Sprays	90	11.4
Coal Conveying	284.5	Enclosure	99	2.8
Bulldozers	29.5		0	29.5
Wind Erosion	97.9	Prompt Revegetation	0	97.9
Haul Road Repair	11.0	Watering	0	11.0
TOTAL	1,087.1			445.8

Source: Peabody Air Quality Permit Application.

Some special air quality permitting requirements are applicable in proposed Area B because it is partially within an area designated as being in nonattainment of the Federal secondary particulate standard. Specifically, the application of Lowest Achievable Emission Rate (LAER) technology is required. DHES has determined that the emission controls proposed represent LAER. If a major stationary source or major modification (as defined by EPA regulations) is proposed for a nonattainment area, any permitted increase in emissions must be offset with a corresponding decrease in emissions in the area. Peabody's proposal does not meet the applicability requirements of a major stationary source or major modification because non-fugitive particulate emissions are less than 250 tons per year from both the existing and proposed operations. For this reason offsets are not required.

Computer modeling to determine the total suspended particulate (TSP) concentrations resulting from proposed mining was performed and submitted as part of Peabody's air quality permit application. The model which was used

is the Climatological Dispersion Model (CDM) developed by EPA. The choice of this model was made in consultation with and approved by DHES. A complete description of the model is included in the application. The maximum annual average TSP concentration outside the permit area was predicted to be 22 ug/m^3 at a point along the proposed permit boundary immediately east and downwind of the proposed active mining area. This maximum annual average would represent an increase of 9 ug/m^3 over the background level of 13 ug/m^3. The maximum predicted 24-hour TSP concentration would be 134 ug/m^3 at the same location along the permit boundary (Peabody Coal Company 1987b).

As described in the air quality section of Chapter III, the basis of the Federal and State ambient particulate standards has recently been changed from TSP to PM-10. A specific impact analysis relevant to PM-10 was not performed; however, using the conservative or worst-case assumption that all of the particulate was less than 10 microns, the predicted concentrations would still be less than the PM-10 standards.

The Air Quality Bureau (DHES) has reviewed Peabody's air quality permit application for alteration of their existing permit and has issued a preliminary determination to approve the permit as proposed. A final decision will be made after the public review process and issuance of the final EIS.

Based on the anticipated level of particulate emission control, the air quality impact off the proposed permit area would be minimal and localized. Peabody would be required as a condition of their air quality permit to incorporate particulate monitoring in Area B into their air monitoring network. Monitoring sites would be chosen in conjunction with DHES. State and Federal quality assurance requirements would be followed to provide accurate and representative data. Particulate monitoring at Area B would be for PM-10 rather than TSP.

At the present time, all particulate emissions are generated in Area A. As initial development begins in proposed Area B, there would be an increase in overall emissions, since activities in Area A would remain essentially unchanged. The beginning of coal production in Area B would correspond with cessation of mining in Area A, although reclamation activities would continue for some time, and use of Area A facilities would continue through the life of the project. In general, development of Area B would result in a shift of most particulate emission sources from Area A to Area B with a corresponding shift of air quality impacts.

Table IV-2 lists the gaseous pollutant sources and estimated emissions for the proposed project. At these levels, the impact on ambient air quality is expected to be minimal.

The Northern Cheyenne Indian Reservation, located about 8 miles south of proposed Area B, is designated as Class I under the Prevention of Significant Deterioration (PSD) regulations. The surrounding area, including the proposed mining area outside of the nonattainment area, is Class II. Class I areas are accorded more stringent protection from air quality degradation.

Table IV-2: Gaseous Pollutant Emission Inventory (tons/yr) for the Proposed Big Sky Area B Mine

Activity	Sulfur Oxides	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Vehicle Exhaust	34	457	38	403
Explosives	1	25	--	6
TOTAL	35	482	38	409

Source: Peabody Air Quality Permit Application.

With respect to Peabody's proposal, a PSD permit and analysis are not required because the proposed project would not be a major stationary source or major modification as described previously.

A related concern is visibility protection on the reservation. Visibility monitoring and analysis were not required for this project; however, a representative study was performed as part of the development of the Final Comprehensive Environmental Impact Study for Western Energy Company's Rosebud Mine (Montana Department of State Lands 1983). The results of this study indicated that visual range would not be degraded by an amount detectable by human observers and the change would be below the detection limits of most instruments used to measure visibility. This was based on the expansion of Western Energy Company's mining operations and is, therefore, similar to Peabody's proposal. The relatively large proportion of large particles in fugitive dust reduces the potential for visibility degradation because large particles do not scatter light as effectively as small particles.

A visibility monitoring network is operated on the reservation using cameras. If a detectable change were to occur, it may be observed by this network. The overall air quality impact, including visibility degradation, on the Northern Cheyenne Indian Reservation is expected to be negligible.

Following completion of mining, air quality conditions would return to near-current levels. The only potential mine-related particulate source would be wind erosion of exposed areas. Given adequate revegetation, these emissions would approximate current conditions.

Impacts Unique to Alternative 4

Current air quality conditions in Area B would remain unchanged under this alternative. Assuming mining activities in Area A would conclude as planned, overall air pollutant levels in the area would be reduced.

Conclusion

DSL and OSMRE conclude that impacts to air quality under Alternatives 1, 2, and 3 would be negligible. There would be a slight improvement in air quality under Alternative 4.

GEOLOGY

Topographic and Geomorphic Impacts Common to Alternatives 1, 2, and 3

The topography would be more subdued following mining. Hills and slopes would be more rounded with the following exceptions: Marmot Mound would not be mined and would remain a prominent feature in the area. Sloping hillsides would end abruptly in bluff extensions (i.e., partially retained highwalls extending existing bluffs).

Mining may increase channel erodibility in several ways. Erosion-resistant bedrock would be removed and replaced with less resistant spoils materials. Channel gradients would increase slightly in several cases due to decreased stream length, and drainage density would decrease (table IV-3).

Postmining stream gradients would increase in Randy Thomas Tributary, Lee Coulee, Bad Bob Gulch, and Fossil Fork. The combination of increased grade and decreased drainage density may result in increased erosion until streams reach equilibrium with conditions following mining. Increased channel erosion would be mitigated as proposed by using concave longitudinal channel profiles, promptly revegetating the reclaimed land, and implementing stable channel designs when reclaiming disturbed areas.

During mining, most sediment produced within the mine area is proposed to be trapped in temporary sediment ponds distributed throughout the mine area and would not adversely affect downstream water quality. Decreased sediment loading in the stream channel could cause the stream channel below the sediment ponds to erode downward. Above the ponds, the stream channel would begin filling with sediment. When the sediment ponds are removed prior to bond release, there would be a short-term increase in channel erosion and sediment production as the stream channel conforms to the new conditions. Natural erosional processes such as headcutting would work upstream through the mined area after completion of mining. Headcuts are already found below the proposed mine on Lee Coulee and are expected to continue to work their way upstream unless they encounter a barrier. Peabody has proposed to repair downcuts when a channel downcuts more than 9 inches. Headcuts would encounter less bedrock since bedrock would be replaced by spoils during mine

Table IV-3: Select Geomorphic Characteristics of Drainages Within the Area to be Affected by Proposed Mining

Drainage Basin	Stream Length (ft)[1]		Gradient (%)[1]		Drainage Density[2,3] (mi/mi2)	
	Premining	Postmining	Premining	Postmining	Premining	Postmining
Lee Coulee	12,730	12,400	.86	.89	1.15	1.21
Gambels Well Trib.	2,020	2,030	1.98	1.97	5.4	4.8
Randy Thomas Trib.	4,700	4,300	1.70	1.86	3.9	3.4
Marmot Mound Trib.	5,010	5,400	1.80	1.67	2.4	2.3
Bad Bob Gulch	9,180	8,500	1.31	1.41	2.3	2.3
Fossil Fork	10,750	9,820	1.02	1.12	2.1	2.1
Gumdrop Gully	1,070	1,640	2.80	1.83	10.0	6.2
I Quit Coulee	3,480	3,700	2.30	2.16	1.4	1.8

[1] Source: Peabody Coal Company.
[2] Estimates based on Peabody Coal Company data and maps. Postmining drainage divides were drawn on Peabody's Exhibit 20-4. Drainage areas within the disturbed area were measured from Peabody's Exhibit 20-4 and 7-8. Drainage densities were calculated using stream length data presented in Peabody's table 17-3. Drainage densities are presented only for those areas that will be disturbed by mining and differ from drainage densities calculated by Peabody for the entire drainage area.
[3] Estimates that 16 bluff extensions will remain.

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reclamation. Bedrock often forms an erosion-resistant barrier that slows the upstream headcutting from eroding the channel bed.

Mining would physically remove a portion of the Rosebud coal seam. The coal would be used as fuel, which would be a permanent loss of the resource. Erosion rates could increase over the short term, but could be reduced by successful reclamation.

Impacts Unique to Alternative 3

Impacts of Alternative 3 are the same as those for Alternatives 1 and 2 except that an additional 35 acres of land will be mined under Alternative 3.

Impacts Unique to Alternative 4

None of the impacts mentioned previously would occur as a result of this alternative.

Conclusion

DSL and OSMRE conclude that topographic and geomorphic impacts under Alternatives 1, 2, and 3 would be minor. There would be no impacts under Alternative 4.

HYDROLOGY

Impacts Common to Alternatives 1, 2, and 3

Surface Water

Mining would physically remove ponds 2, 3, and 4 in Lee Coulee (see figure IV-2); two unnamed ponds in Sections 24 and 25, T1N, R40E; and one unnamed pond in Section 31, T1N, R41E. Pond 1, located between the proposed mine area and the major sediment pond in Lee Coulee below the proposed disturbance area, is likely to fill with sediment during the course of mining.

The wet reach of Lee Coulee occurs upstream from the McKay coal cropline near the center of Section 30, T1N, R40E, and extends approximately 1.5 miles upstream. Aquitards in the alluvial, overburden, coal, and interburden aquifers cause the water table to intercept the stream channel in this reach. Mining is likely to alter the upper portion of this wet reach, removing aquitards in the alluvial, overburden, and Rosebud coal aquifers. The postmining water table may not intercept the stream channel following mining, and flowing water may not persist in this upper reach of Lee Coulee into the summer as it now does.

The lower portion of this wet reach may redevelop following mining. The interburden below the Rosebud seam would not be disturbed by mining and would probably serve as an aquitard as it now does, causing water to flow seasonally for a short distance (at least 100 yards) in Lee Coulee. After water flowing in Lee Coulee passes the McKay coal cropline, it is expected to seep into the alluvium and sub-McKay aquifers and flow underground to Rosebud Creek as it now does.

Two springs, Gumdrop Spring and the Bailey Spring (see figure IV-2), are likely to be dewatered during mining due to pumping excess water from the pits, assuming the water table is not perched at either of the springs. Flow in both springs is likely to be restored after pumping in the nearby (within about 4,000 feet) boxcuts is completed.

Peabody Coal Company (1987a) estimated that average TDS concentrations would increase by 3.4 percent in Rosebud Creek below the confluence of Lee Coulee. TDS could increase in the waters of the Rosebud Creek alluvium below Lee Coulee by 5 percent due to spoils water flowing through the Lee Coulee alluvium (Peabody Coal Company 1987a). Water reaching the Rosebud Creek

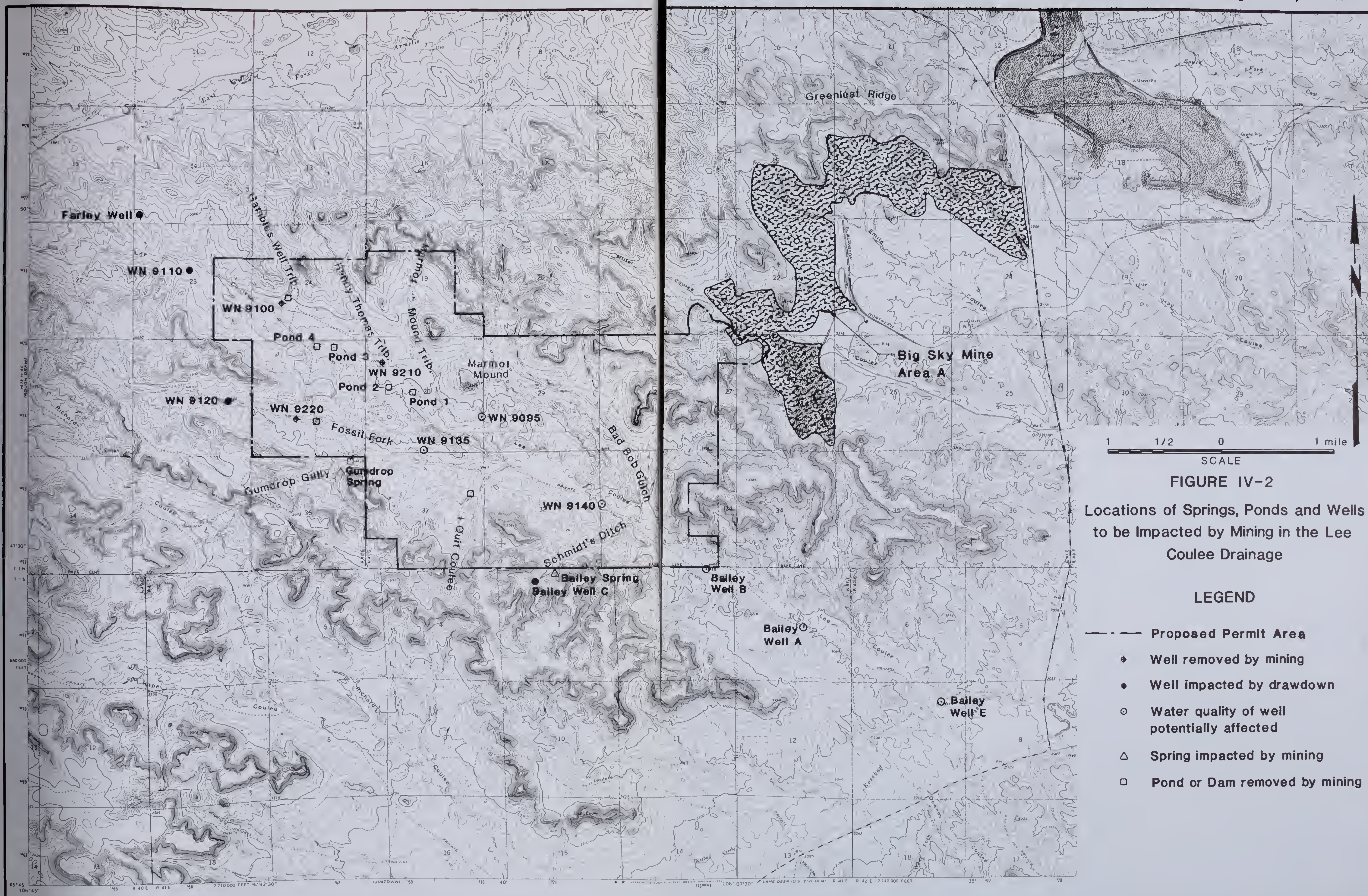

FIGURE IV-2

Locations of Springs, Ponds and Wells to be Impacted by Mining in the Lee Coulee Drainage

alluvium via the sub-McKay aquifer could increase by 10.8 percent (Peabody Coal Company 1987a). It is possible that geochemical reactions between ground water from spoils and minerals in the aquifers between the mined area and Rosebud Creek could reduce TDS loads before the spoils water reaches Rosebud Creek. Such reactions are not considered in these estimates.

The spoils water flowing through the Lee Coulee alluvium is expected to reach Rosebud Creek much sooner than spoils water flowing through the sub-McKay aquifer. It is estimated that it would take 97 years for spoils water flowing through the Lee Coulee alluvium to reach Rosebud Creek and 500 years for water flowing through the sub-McKay aquifer to reach Rosebud Creek. If spoils water from both aquifers reaches the Rosebud Creek alluvium at the same time, it is estimated that TDS concentrations could increase by 11 percent (see Appendix for calculations).

During mining, sediment ponds are likely to reduce the amount of water flowing in the drainage during a storm because the ponds would store flows and slowly lose water to seepage and evaporation. This reduction in surface flow would be most noticeable during small- to moderate-sized storms, but any impact on Rosebud Creek, which has an average annual discharge of 27,200 acre-feet near Colstrip, would be minor. The sediment ponds would be designed to handle runoff from the 10-year, 24-hour storm. Not all ponds would be in place at one time (see table II-2). The maximum storage capacity of ponds in place at one time is expected to be about 350 acre-feet. Runoff from larger storms could cause the ponds to discharge.

Ground Water

Two wells, for which water rights have not been filed (WN 9100 and WN 9220), would be physically removed by mining. Well WN 9210 in Section 30, T1N, R41E, also would be removed by mining.

Figure IV-2 shows wells most likely to experience water drawdowns of 5 feet or more. However, such drawdowns may not preclude the use of a given well. Assuming that the two wells located in Section 35 are completed in an aquifer below the Rosebud coal, they should not be adversely affected by mining. Three wells (WN 9120, WN 9110, and Bailey well C) could experience drawdowns greater than 5 feet due to pumping of excess water from the pits. Bailey well C may be dewatered. Detailed data are not available for well WN 9120; however, assuming it is completed in the overburden or Rosebud coal, the well would experience a drawdown of 5 feet or more. Well WN 9110 is predicted to experience at least a 19 percent drawdown due to mining in proposed Area B. This well has approximately 63 feet of water available in the well bore. Depending on the timing of mining in Western Energy Company's Area C, additional drawdowns could occur in well WN 9110 due to pumping of excess water from nearby Western Energy Company mine.

The Farley well in Section 14, T1N, R40E, may experience slight drawdowns from the proposed mine in addition to drawdowns from Western Energy Company's mine in Area C. Again, the timing of mining in each area would be important in determining how great the drawdowns would be in this well.

Water right claims have been filed on three wells that have not been found on the ground by Peabody. The first of these wells is reported to be located in the SE1/4 of Section 36, T1N, R40E. If there is a well in this area and it is completed in the overburden or Rosebud coal, it too would experience drawdowns of at least 5 feet. The second of these wells is reported to be located in Section 30, T1N, R41E, and could be removed by mining. The last well is reported to be located in the SW1/4 of Section 28, T1N, R41E. It could be removed by mining or impacted by degraded spoils water.

Within the proposed permit area boundary, three wells (WN 9140, WN 9135, and WN 9095) are located downgradient from proposed mining. These wells are completed in the sub-McKay or alluvial aquifer and may be adversely affected by degraded spoils water.

Three wells (Bailey wells A, B, and E) located outside the proposed permit area and downgradient from mining may be adversely affected. These wells probably are completed in the sub-McKay or alluvial aquifers through which degraded spoils water would travel as it moves toward Rosebud Creek. Water quality in these wells may be degraded as the plume of degraded spoils water moves down the Lee Coulee drainage. Farther from the proposed mine, the effects of degraded water quality would be lessened by dilution from adjacent unmined areas and possibly from geochemical reactions between spoils water and clay particles in the aquifers.

Redistributed soils and spoils generally would have permeabilities and porosities greater than premining conditions. Within the Lee Coulee drainage, clinker-covered ridges serve as local ground water recharge areas; most of these areas would remain undisturbed by mining.

Ground water flowing through mine spoils in Big Sky Area A has average TDS concentrations of 4,245 mg/l—2.3 times that of premining concentrations (Peabody Coal Company 1987a). Ground water emanating from proposed Area B also would be degraded, possibly to the point where it would not be suitable for use by cattle (more than 5,000 mg/l TDS). In the southern portion of the permit area, core samples showed high percentages of smectite, a clay mineral associated with shales and siltstones. Higher sodium levels are expected in the ground water flowing through this area. In addition, the sulfate concentration in the overburden is approximately 10 times greater than the mean concentration of bicarbonate. Thus, the postmining ground water might be dominated by sulfate anions.

Within the proposed permit area, it is likely that replacement wells in the sub-McKay aquifer would have water with TDS concentrations of less than 5,000 mg/l, which would be suitable for use by cattle. Sulfate concentrations in the sub-McKay aquifer range from about 600 to just over

3,000 mg/l, with an average of 1,339 mg/l. Sulfate levels in water to be used by lactating cows and calves should not be greater than 2,500 mg/l (Munshower 1986). Replacement wells downgradient from the proposed mine would have to be completed in a deeper aquifer if water quality in the sub-McKay were significantly degraded by spoils water.

Impacts Unique to Alternative 1

Impacts to water supplies would be reduced, in part, by replacement of affected wells upon completion of mining. It is assumed that Peabody would replace some, but not all, wells rendered non-functional by mining.

Water supplies would be lost in the wet reach of Lee Coulee due to summer flow reductions. Ponds in the upper portion of this reach probably would not contain water in the summer.

Impacts Unique to Alternative 2

Wells and surface water supplies would be replaced by Peabody without regard to the presence or absence of water rights. However, the cost of maintaining wells and ponds would be borne by Peabody or the landowner who acquires the land from Peabody after it has been reclaimed.

Requiring that the concentration of sulfate and TDS in replaced water supplies be less than 2,500 and 5,000 mg/l, respectively, would assure postmining water quality suitable for use by cattle.

Impacts Unique to Alternative 3

Under Alternative 3, the pond below Gumdrop Spring in Section 36, T1N, R40E would be removed by mining and replaced by a new impoundment. Impacts to surface water supplies would be short term and minimal since Gumdrop Spring would not be disturbed.

Impacts Unique to Alternative 4

None of the impacts mentioned previously would occur as a result of this alternative.

Cumulative Impacts

In the Rosebud Creek drainage, both surface and ground water quality would be degraded by mining. Irrigation return flows and ground water flowing from mined areas would both contribute to increased TDS loads in Rosebud Creek. Using a model developed by USGS (Ferreira 1984), it is estimated that irrigation return flows in the Rosebud Creek drainage would

contribute an average of 3 percent to the increased TDS load while mining activities (both historic mining and foreseeable future mining) would raise the TDS levels in Rosebud Creek near the mouth by 1.7 percent in an average water year.

The USGS model uses a different approach than the estimating method used by Peabody. Both approaches show small increases in TDS under average flow conditions. However in low flow years, irrigators occasionally forego the use of water in the lower portion of Rosebud Creek because of elevated TDS concentrations (E. Griffith, pers. comm., 1988). Mining could exacerbate the TDS problem in low-flow years.

It is possible that geochemical reactions between degraded water from spoils and minerals in the aquifers between the mined area and Rosebud Creek could reduce TDS loads reaching Rosebud Creek. Such reactions are not considered in the USGS model.

Aquifers have been destroyed in portions of tributaries to Rosebud Creek including Lee Coulee, Miller Coulee, Hay Coulee, Cow Creek, and Pony Creek. Spoils aquifers will redevelop in these areas. Where springs and wells have been removed by recent mining, they have been replaced with alternative water sources, as required by DSL.

Conclusion

DSL and OSMRE conclude that impacts to surface and ground water resources under Alternative 1 would be moderate. Impacts under Alternatives 2 and 3 would be minor. There would be no impacts under Alternative 4.

AQUATIC LIFE

Impacts Common to Alternatives 1, 2, and 3

Mining would remove ponds 2 and 3 and fill pond 1 with sediment (see figure III-1). The existing aquatic populations would be destroyed. TDS levels in the downstream stretch of Lee Coulee would increase during mining. Baseline data are unavailable for this stretch; however, macroinvertebrates are probably similar to those in the ponds and would tolerate small TDS increases. The slight TDS increases predicted in Rosebud Creek due to Peabody's proposed mining or the cumulative impacts would affect neither fish nor macroinvertebrates.

Impacts Unique to Alternative 1

Under this alternative aquatic populations would not be replaced.

Impacts Unique to Alternative 2

Under this alternative, stock tanks with overflow ponds would be established in Lee Coulee. Macroinvertebrates would slowly repopulate these new sources of water. However, these smaller and more uniform water sources would support postmining populations less diverse and less abundant than premining populations.

Impacts Unique to Alternative 3

Mining under this alternative would remove Gumdrop Spring pond. The macroinvertebrates inhabiting the pond would be destroyed. The spring itself would remain unharmed; the pond could be reestablished and macroinvertebrates would eventually return to it.

Impacts Unique to Alternative 4

Under this alternative, none of the impacts discussed for Alternatives 1, 2, and 3 would occur.

Conclusion

DSL and OSMRE conclude that impacts to aquatic life under Alternative 1 would be moderate. Impacts under Alternatives 2 and 3 would be minor. There would be no impacts under Alternative 4.

SOILS

Impacts Common to Alternatives 1, 2, and 3

Soil impacts would occur during soil salvage, storage, and replacement. These impacts include reduction of soil porosity, alteration of soil structure, and dilution of organic matter in soil horizons. Microbial activity also would be reduced temporarily in the reconstructed mine soil. Soil erosion would be a problem until vegetation is reestablished.

Biological impacts would occur in most salvaged soils, especially in those requiring stockpiling. Loss of viable seeds, nutrients, and soil micro-organisms would alter soil characteristics and increase revegetation difficulties. Proposed direct hauling of soil and two-lift salvage would mitigate revegetation problems.

Physically, soil salvage and replacement lowers soil porosity, alters soil structure, and, in cases of soil blending, may change the soil texture. As a result, infiltration and water-holding capacity are reduced, soil erosion potential increases, and soil aridity increases. Peabody plans to

deep-rip the replaced soil on contour to reduce compaction, increase infiltration, and reduce runoff.

Increased surface water infiltration could cause localized piping and widespread settling of spoils. Differences in soil compaction and differential distribution of spoils material also could lead to piping after reclamation. High sodium spoils, subject to dispersion, could result in voids in the spoils contributing to settling and piping. Careful placement of the shale rock outcrop material, which is sodic and high in clay, would mitigate piping potential.

Settling would likely occur regardless of the method of spoils and soil placement; however, reduction of high clay concentrations in spoils would help mitigate settling. Piping could be mitigated by minimizing differential compaction in the spoils and by placing sodic spoils where water saturation would be unlikely to occur. Maintaining a reasonable stream gradient in postmine alluvial channels to minimize infiltration into the spoils, and ensuring that the interface between the spoils and undisturbed soil cannot be penetrated by surface water flow also would minimize the risk of piping. Application of these reclamation techniques and successful revegetation would adequately mitigate soil physical impacts.

<u>Impacts Unique to Alternative 1</u>

Revegetation and reconstruction of alluvial channels would be difficult if soil and spoils from shale rock outcrops are utilized in reclamation. High clay and sodium content would inhibit plant growth, resulting in soil erosion and sediment production.

Soils with an excess of coarse fragments, high clay content, high salinity, high sodicity, or loamy sand texture would be mixed with soils with desirable reclamation characteristics. Mixing of toxic or potentially toxic soils with non-toxic soils would mitigate impacts to vegetation during reclamation. Soils with undesirable reclamation characteristics cover about 12 percent of the area to be disturbed (see Appendix).

<u>Impacts Common to Alternatives 2 and 3</u>

Problems with revegetation due to adverse chemical and physical properties of spoils from shale rock outcrops could be avoided by placing the materials below plant rooting zones. Placement of problem spoils high on slopes would also minimize the mobilization of soluble salts and saturation which could contribute to piping and localized subsidence.

<u>Impacts Unique to Alternative 4</u>

None of the impacts predicted under the previous alternatives would occur.

Conclusion

DSL and OSMRE conclude that impacts to soils under Alternative 1 would be minor. Impacts under Alternatives 2 and 3 would be negligible. There would be no impacts under Alternative 4.

VEGETATION

Impacts Common to Alternatives 1, 2, and 3

Mining would destroy 3,200 acres of existing vegetation (3,240 acres for Alternative 3). Over 80 percent of the affected vegetation would be grassland or shrub-grassland types (table III-5 - Chapter III). A significant amount of ponderosa pine dominated plant communities (327 acres) also would be removed. In addition, 24 acres of rock outcrops and previously disturbed land would be mined.

Mining also would affect the vegetation found in Lee Coulee between the pit and the McKay cropline. A sediment pond would remove an unknown amount of vegetation. Reduced moisture in the rest of this coulee segment (see Hydrology - Chapter IV) would lower growth and vigor of plants adapted to relatively high soil moisture levels. These plants probably would be replaced by invader species and species able to grow on drier sites. Years after final reclamation, premining hydrology would be reestablished and the premining vegetation would recolonize the area.

An undetermined number of small-flowered evening primrose plants could be lost to the pit or haul road. This species is classified as rare by Lesica et al. (1984) and as critically imperiled by the Montana Natural Heritage Program (1988).

General Revegetation

Revegetation would begin after each of the mining pits are backfilled, graded, and the soil is replaced. Thus, only facility sites, sediment ponds, soil stockpile sites, and roads would not be revegetated until mining is completed. The proportions of vegetation types in the reclaimed landscape would be vastly different from the proportions found in the existing environment. Agricultural and breaks types would be eliminated. Shrublands would be reduced while grasslands would be greatly increased, providing more acres of forage for livestock.

Postmining livestock forage production probably would increase after reclamation. Increased production on reclaimed areas has been observed by Lang (1982), Schafer (1984), Richardson et al. (1975), and Currie (1981). Factors contributing to higher productivity include reduced plant competition, increased nutrient availability after soil disturbance, high productivity of species in seeding mixtures, and increased soil depths (Hofmann and Ries 1980, Lang 1982).

Over the long term, production would decline as litter builds up, some plants become root-bound, and the highly productive but non-persistent species die out (Montana Agricultural Experiment Station 1978). Assuming proper range management and favorable climatic conditions, postmining productivity would be expected to remain above premining levels.

Plant diversity after reclamation would be lower than at present. This reduction would be caused by: (1) lower number of species in seeding mixtures than occurring naturally; (2) loss of microsites during soil replacement; (3) initial dominance by rapidly growing and productive species in the seeding mixtures (i.e., cool-season grasses, especially wheatgrasses); and (4) simplification of the intricate premine mosaic of vegetation types (Montana Agricultural Experiment Station 1978, Richardson et al. 1975, Rennick and Munshower 1985). Reduced plant diversity could impact both livestock and wildlife.

Peabody's revegetation plan includes measures that would minimize the anticipated reduction in diversity. These measures include large proportions of warm-season grasses in seed mixtures, use of broadcast seeding and special seeding methods, omission of fertilizer, and direct hauling of soil. Direct-hauled soil is an important source of viable seeds and plant parts from premining vegetation types (Rennick and Munshower 1985). Invasion of plants from adjacent undisturbed areas would further increase plant diversity.

Drainage Bottoms

After mining, reconstructed drainages would contain fewer shrubs than at present. Snowberry density would be reduced (see table III-6 - Chapter III). Peabody, however, would plant clusters of tree and shrub seedlings in drainages. The survival of the seedlings would depend on moisture availability. It is likely that substantial portions of the drainages would be quite dry (see Hydrology - Chapter IV). Thus, moisture-reliant species (such as cottonwood and chokecherry) in several of the clusters would die. Research indicates that mortality of other species would range from 0 to 50 percent (Brown and Martinson 1959, Bjugstad et al. 1981, Jensen and Hodder 1979, Amendola et al. 1984, Everett 1980). Planting rates (see Appendix) are high enough to accommodate this mortality and still exceed premining densities (except for snowberry). For clusters located in moist drainage portions, some seedlings of all species would survive.

Major obstacles to establishment of woody plants would be a dry year during seedling planting and damage by browsing animals. Bjugstad et al. (1984) noted that most woody species become established only during years of average to above-average precipitation. Removing livestock from reclaimed lands for 2 years or more would protect most woody plants from livestock damage. However, maintaining proper stocking rates and livestock distribution after that time would be necessary to ensure the plants' continued survival. Damage to seedlings by deer and rodents would be difficult to control. The magnitude of the loss due to wildlife depredation cannot be predicted.

Grass species adapted to wet sites make up a substantial portion of the mixes that would be seeded in drainages (see Appendix). When sown in the drier portions of reconstructed drainages, these grasses probably would not survive. Conversely, species such as blue grama and prairie sandreed are adapted to dry sites and would not grow in the moister drainage segments. Vegetation directly dependent on existing ponds, such as bulrush and aquatic species, would probably be absent from the reclaimed landscape.

Uplands--Woody Species

The proposed rates (see Appendix) and methods for planting conifer seedlings suggest that premining conifer densities (table III-6 - Chapter III) could be achieved. Planting rates would allow for up to 60 percent mortality before seedling densities would drop below premining densities. Research indicates that allowing for 40 to 60 percent mortality is appropriate (Amendola et al. 1984, Orr 1977, Hite 1977, Stewart and Beebe 1974). Peabody's commitment to use only containerized seedlings and to control competing herbaceous vegetation also would increase chances for the reestablishment of coniferous forests. However, droughts and animal damage could destroy the seedlings (Vance and Running 1985). Blake (1982) suggests that if planted conifers survive to about 5 years, they may be considered established. At this age, the trees resist drought and browsing and mortality rates fall substantially.

Several decades would pass before planted trees would reach the heights found in premining forests. Seeds from mature trees would eventually allow reestablished forests to increase in density. Seeds from undisturbed but adjacent conifers would fall onto the edges of reclaimed areas, eventually establishing natural reproduction.

With Peabody's proposed revegetation plans (table IV-4) and shrub planting rates (see Appendix), the extent and density of upland shrubs would be greatly reduced after reclamation. Subsequent mortality of planted shrubs would lower the density even further. Over the long term, shrubs such as sagebrush and rabbitbrush could increase.

Impacts Unique to Alternative 1

Ponderosa pine types, presently covering 327 acres of the disturbance area would be reduced to 34 acres (table IV-4). Soils in reconstructed drainages would tend to erode and cause localized vegetation failures. Toxic-forming materials would inhibit plant growth in some areas with deep-rooted species intolerant of sodium being most affected. Small-flowered evening primrose could be removed or damaged by mining activities under this alternative.

Table IV-4: Disturbance Area Acreages of Premining and Reclamation Types

Premining Type	Acres	Acres of Reclamation Types: Alternative 1	Acres of Reclamation Types: Alternative 2
Needle-and-thread grassland	978	2,375	2,049 to 2,115
Sidehill grassland, skunkbush sumac	506	264	264
Big sagebrush, silver sagebrush (uplands)	592	311	311
Ponderosa pine types[1]	327	34	294 to 360
Riparian grass	49	74	74
Mesophytic shrub, deciduous tree and silver sagebrush (drainage)	332	142	142
Breaks complex	221	0	0
Agricultural types	159	0	0
Miscellaneous	24	0	0
TOTALS	3,200	3,200	3,200[2]

[1]Ponderosa pine/snowberry would not be reclaimed and is not included.
[2]Increase by 34 acres for Alternative 3. Assume that several types would make up this acreage.

Impacts Unique to Alternative 2

There are no negative impacts unique to Alternative 2. Required mitigation would increase the acreage of reestablished ponderosa pine while reducing soil erosion and minimizing the use of potentially toxic spoils. Opportunities for reducing impacts to small-flowered evening primrose would be explored.

Impacts Unique to Alternative 3

Expanding the mining pit would slightly increase the disturbance of existing vegetation. Revegetation methods and success would be similar to those mentioned for Alternative 2.

Impacts Unique to Alternative 4

Under Alternative 4, none of the vegetation effects discussed for Alternatives 1, 2, and 3 would occur.

Conclusion

DSL and OSMRE conclude that impacts to plant communities under Alternative 1 would be minor. Impacts under Alternatives 2 and 3 would be negligible. There would be no impacts under Alternative 4. Impacts to the small-flowered evening primrose would be moderate under Alternative 1 and minor under Alternatives 2 and 3.

WILDLIFE

Impacts Common to Alternatives 1, 2, and 3

Wildlife Habitats

Proposed mining would remove, over a 23-year period, 3,200 acres of existing habitats. Forty-three percent of the affected habitat would be grasslands, while shrublands would make up 37 percent. The remainder would consist of agricultural land, ponderosa pine types, and coulee bottom vegetation. Mining also would destroy existing water sources in Lee Coulee and its tributaries. Wildlife use has been documented for the Lee Coulee water sources and is suspected for the other sources.

The advancing mine pit would destroy populations of small, less mobile species, and displace more mobile species. Displaced animals would move into surrounding habitats where they would compete for resources with resident wildlife. If resident populations are at carrying capacity, the competition would result in an overall population decline. However, carrying capacities of surrounding habitats are difficult to measure and the size of resultant population changes cannot be predicted.

In addition to competitive effects, displaced wildlife may encounter other problems. For example, mule deer would forage in adjacent croplands. Animals that move north would encounter previously and currently mined land (see Cumulative Impacts).

Reclamation, if it followed mining across the landscape, would allow wildlife use of disturbed areas before all mining ceased. However, revegetation would substantially change the proportion of habitat types in the disturbance area (table IV-4). Grassland types would increase at the expense of shrubland types. Clinker-clay outcrop and agricultural areas would be eliminated. Natural rock outcrops would be replaced by bluff extensions (i.e., partially retained highwalls extending existing bluffs) and rock piles. Reclamation would simplify both the premining mosaic of habitat types and the existing topography.

Revegetation with herbaceous plants would provide forage and some cover for wildlife. The reduction in the shrub acreage and density would be expected to lower animal diversity (Parmenter et al. 1985). Declines in plant diversity (see Vegetation - Chapter IV) and the simplified topography would further lower animal diversity (Steele and Grant 1982). Over time, these impacts would become less severe as herbaceous plants and shrubs increased. However, Parmenter et al. (1985) have noted that shrubland restoration requires "extremely long periods of time."

Mule Deer

Observations made by Peabody do not reveal any mule deer concentrations within the proposed disturbance area. However, the area contains substantial amounts of important deer habitats (table III-9 - Chapter III), and DFWP has identified the eastern portion of the disturbance area as winter range.

Mule deer would react to habitat destruction by moving into surrounding suitable habitats. The noise and activity of mining (blasting, dragline operation) may further displace mule deer. Studies on deer response to roads (Rost and Bailey 1979, Perry and Overly 1977) suggest that deer use would decrease in all areas within 1/8 mile of mining.

Mule deer would become accustomed to mining activity and would return to revegetated lands. Mule deer use of revegetated lands has been noted at several Montana coal mines, including Peabody's Big Sky Area A Mine, the Absaloka Mine, and the Rosebud Mine. Collins and Urness (1983) speculate that mule deer are innately motivated to explore new habitats; this characteristic would attract them to revegetated areas. Furthermore, deer find attractive forage in reclaimed lands (Medcraft and Clark 1986). Some species in Peabody's mixtures, such as alfalfa and saltbush, are easily established and provide summer and fall forage for deer. Deer also may feed in reclaimed grasslands in the spring and fall as cool-season grasses "green up." The value of reclaimed areas to mule deer may be overestimated because (1) deer are easily observed in open habitats; (2) many deer may only be traversing reclaimed lands when observed (Parmenter et al. 1985); and (3) highly mobile deer may use reclaimed lands to satisfy only a part of their habitat requirements (Hayden-Wing 1984).

Despite the increase in seasonal forage, proposed mining and reclamation would lower the overall value of deer habitat in the disturbance area. The decrease in shrubs and plant diversity may reduce year-round forage (Parmenter et al. 1985, Dusek 1975). Simplifying the habitat mosaic and the topography would force deer to range farther to satisfy their needs (Steele and Grant 1982). Eliminating the reliable premining water sources also may increase deer movements. When planted trees and coulee bottom shrubs mature, they would supply cover for deer; however, maturation would take decades.

Road kills of deer by haul road traffic would be negligible. Since the mine expansion would not increase the human population, indirect impacts (such as housing construction, recreation, and poaching) also would be minor.

Changes in local mule deer populations, due to Peabody Area B mining, caused by displacement and habitat change cannot be predicted. It is likely, however, that any population changes would not be readily noticed. Mining would not affect regional populations of mule deer.

Pronghorn

The low number of pronghorn observations indicates that the proposed disturbance area is not important range. However, mining would remove about 1 1/2 square miles of BLM-identified range and may initially force pronghorn 0.3 to 0.6 miles beyond the disturbance area. Eventually, pronghorn would habituate to the regular and predictable mining activities (Segerstrom 1982).

After reclamation, pronghorn use of the disturbance area may equal or exceed premining use. The gentler terrain and increase in grasslands would improve habitat, although this would be partially tempered by the removal of reliable water sources. Scarcity of sagebrush for winter forage and forbs for summer forage would inhibit achievement of optimum habitat conditions (Segerstrom 1982, Medcraft and Clark 1986). Overall, mining and reclamation would have little impact on local or regional pronghorn populations.

Other Mammals

Mining would displace coyotes and other mammals from the proposed disturbance area. The wide-ranging coyote would be able to satisfy its life requirements in off-site habitats. Population impacts on other mammals would be unnoticeable and reclaimed lands would eventually supply suitable habitat. However, species that depend on dense, woody vegetation (bobcats, weasels, skunks, porcupines, squirrels, and cottontails) would use reclaimed areas infrequently until planted trees and shrubs grow to sufficient height to supply cover.

Dense herbaceous cover and rock piles would encourage small mammals to repopulate reclaimed areas. In fact, small mammals may be more abundant than prior to mining. Peabody data (1984) suggest that two species (western harvest mice and deer mice) would make up most of the population. Reclaimed lands often supply habitat for abundant populations of few species (Hingten and Clark 1984, Hayden-Wing 1984, Steele and Grant 1982).

Gamebirds

Mining would destroy a dancing ground used every spring by sharp-tailed grouse. Sharptails may respond to this loss by moving to another active ground or establishing a new ground. However, the time lag between

disturbance and these responses would decrease reproductive opportunity (Baydack and Hein 1987). Furthermore, competition from resident grouse may inhibit the breeding success of relocating birds. Establishing new grounds may occur only if the overall population increases (R. Eng, pers. comm., 1986).

Reduced acreages of woody species after reclamation would decrease cover for sharptails. As planted trees and shrubs mature, cover supply would increase. Grouse may eventually reestablish dancing grounds in reclaimed areas.

Mining and reclamation would reduce potential cover for turkeys, partridge, and pheasant; however, population impacts would be minor. Eliminating natural water sources could prevent use of the area by waterfowl.

Raptors (Birds of Prey)

Raptors would have their hunting habitat slightly reduced during proposed mining, but reclamation and repopulation by small mammals and songbirds that serve as prey would make the effect temporary. Mining would remove nesting cavities for kestrels. Planted ponderosa pine would not be tall enough to serve as hawk nest sites for decades. Highwalls with artificial aeries would supply potential raptor nest sites.

The mining pit would be within 500 feet of the western prairie falcon nest. Mining activity probably would cause desertion or would prevent the use of the nest. Prairie falcons are intolerant of intense activity within 1/4 mile of their nest (Becker and Ball 1983, Call 1979, Suter and Joness 1981). Mining would abut Marmot Mound and have similar impacts on the golden eagle and merlin nests. If displaced before egg laying, the birds might find other suitable nest sites. Desertion of an active nest would reduce the annual production of the three species.

Songbirds

Grassland songbirds, such as meadowlarks and lark buntings, would be more abundant than forest species after reclamation. Planted trees and shrubs would have to grow to sufficient size before birds such as black-capped chickadees and rufous-sided towhees would repopulate the area. The loss of reliable water sources may discourage birds like red-winged blackbirds and yellow warblers from returning. The decreased diversity of songbirds caused by simpler topography and vegetation would be partially offset by leaving highwalls (Steele and Grant 1982).

Herptofauna

The failure to establish reliable water sources during reclamation would eliminate habitat for frogs and turtles. Toads and garter snakes also may be

absent after mining. Other species of snakes would return to hunt small mammals and hide in rock piles.

Threatened and Endangered Wildlife Species

OSMRE is consulting with USFWS concerning the effect of the proposal on threatened wildlife species that could occur in the area. Since peregrine falcons and bald eagles rarely use the proposed disturbance area, mining would not impact these species. The lack of black-footed ferret observations or habitat indicates that this species would not be impacted.

Impacts Unique to Alternative 1

Failure to replace water sources during reclamation would reduce the quality of wildlife habitat. Deer, pronghorn, turkeys, and grouse would have to travel to off-site water sources. Waterfowl, turtles, and amphibians would no longer use the area. Some species of songbirds would not return.

The large reduction in acreage of ponderosa pine would reduce cover for mule deer while increasing pronghorn habitat. Potential turkey habitat would be lost and grouse cover would be reduced. Forest songbirds also would lose habitat.

The artificial nest sites proposed by Peabody may not be completed in time to mitigate the impacts to nesting golden eagles. Nesting by kestrels would be eliminated until natural cavities develop. Perch sites for raptors and other birds would be reduced.

Projected erosion of coulee bottom soils and use of toxic spoils in plant rooting zones would cause localized vegetation failures. These failures would reduce food and cover for wildlife.

Impacts Unique to Alternative 2

Mitigation measures required under this alternative would reduce the wildlife impacts of mining Big Sky Area B. The replacement of ponds and seeps with wells would supply water for wildlife. However, some animals (such as waterfowl and turtles) may not be able to use water in this form. The long-term reliability of these water sources is questionable. If the wells and tanks are not maintained, wildlife would eventually have to use off-site water sources.

Increasing the acreage of ponderosa pine would improve postmining habitat for deer, turkeys, grouse, and forest songbirds. However, the opportunity to increase potential pronghorn habitat would be foregone. Mitigation to prevent soil erosion and contamination would increase postmining vegetation for wildlife use.

Placing nest boxes and snags on reclaimed land would increase nesting and perching opportunities for birds. Minimizing disturbance to nesting raptors and ensuring the timely development of artificial nest sites would benefit raptors.

Impacts Unique to Alternative 3

Increasing the disturbance area and temporarily removing a pond (see Hydrology - Chapter IV) would slightly change impacts to wildlife. All other impacts would be similar to these covered under Impacts Unique to Alternative 2.

Impacts Unique to Alternative 4

Under Alternative 4, none of the impacts to wildlife discussed for Alternatives 1, 2, or 3 would occur.

Cumulative Impacts Common to Alternatives 1, 2, and 3

Coal mining is the only activity in the study area that would affect mule deer (figure IV-1). Western Energy Company has not completed mining in Area A. The company currently operates in Area B and proposes to expand to Area C. Peabody is approaching the end of operations in its Big Sky Area A.

Impacts to mule deer due to Western Energy Company's Rosebud Mine are similar to those described previously for Peabody's current proposal. These impacts include displacement during mining and reduction in habitat quality after reclamation. Reclamation of Areas A and B has substantially increased grassland at the expense of ponderosa pine and shrubland habitats (table IV-5). This trend would continue at Area C.

The reduction in shrubland and ponderosa pine at the Rosebud Mine adversely affects mule deer (Montana Department of State Lands and Office of Surface Mining 1983). This impact is caused mainly by a postmining decrease in cover and year-round forage. Although acreage changes are unavailable for Peabody's Big Sky Area A, negative impacts also occurred in this area. The topography and vegetation that historically provided winter range were not replaced by reclamation (Montana Department of State Lands and U.S. Geological Survey 1978).

Cumulative impacts to deer are best represented by summing changes in habitat acreages (table IV-5). Past, present, and future mining removes vast areas of habitat types essential to mule deer, and these losses have considerable negative impacts on mule deer populations in the cumulative impact study area (figure IV-1). Impacts may extend throughout the cumulative impact area; however, impacts to regional populations would be minor.

Table IV-5: Estimated Changes in Acres of Mule Deer Habitat at the Rosebud Mine (Areas A, B, and C) and Peabody's Proposed Area B

	Rosebud Mine[1]			Peabody Area B		Cumulative Change[3]	
Habitat Type	Area A	Area B	Area C	Alt. 1	Alt. 2[2]	Alt. 1.	Alt. 2
Grassland	+959	+422	+2,868	+1,229	+936	+5,478	+5,185
Shrubland[4]	-919	-243	-1,966	- 646	-646	-3,774	-3,774
Ponderosa pine	-402	- 96	- 355	- 305	- 12	-1,158	- 865

[1] Approximate acres from Final Comprehensive Environmental Impact Study for Rosebud Mine (Montana Department of State Lands and Office of Surface Mining 1983).
[2] Median was used for grassland and ponderosa pine acreage. Acreages for Alternative 3 would be slightly greater.
[3] Does not include the 855 acres of habitats affected by Peabody's Area A.
Acres of revegetation types were unavailable.
[4] Includes both uplands and drainages.

Conclusion

DSL and OSMRE conclude that impacts to wildlife under Alternative 1 would be minor. Impacts under Alternatives 2 and 3 would be negligible. There would be no impacts under Alternative 4. Cumulative impacts to mule deer under Alternatives 1, 2, and 3 would be moderate. There would be no cumulative impacts to mule deer under Alternative 4.

FISCAL

Impacts Common to Alternatives 1, 2, and 3

Rosebud County Taxes

Proposed mining operations at Area B would require new equipment and improvements with an estimated market value of $5.3 million (J. Lunan, pers. comm., 1988). The taxable valuation of this equipment and improvements would be between $.6 million and $.7 million, increasing the property and gross proceeds taxes paid by the Big Sky Mine from $1.23 million in 1987 to approximately $1.29 million.

State and Federal Taxes

Under the proposed mining plan, severance tax payments for coal mined from Area B would be lower than this for several reasons. The proposed mine plan indicates less production (2.8 million tons per year), and the severance tax rate is scheduled to fall to 20 percent in July 1990 and 15 percent in July 1991. If the 1987 price of $7.67 per ton were to remain constant for the life of Area B, the Big Sky Mine would pay severance taxes of $4.8 million in 1990, $3.8 million in 1991, and $3.2 million in succeeding years. Actual severance tax payments could be higher or lower, depending on whether production and price are above or below 2.8 million tons and $7.67 per ton, respectively.

The Federal government owns the coal under 4-5/16 sections in the proposed mine permit area. Peabody's proposed mine plan indicates that Federal coal would be mined intermittently from 1990 through 2004 and from 2010 through 2012. Peabody would be required to pay royalties of 12.5 percent of the mine mouth price to the Federal government for this coal (D. Gilchrist, pers. comm., 1988); half of the royalties would be returned to the State.

Impacts Unique to Alternative 4

If Peabody is denied the approvals to mine Area B, 53.5 million tons of coal with an average 1987 mine mouth price of $7.67 per ton would not be mined. Since coal is abundant, this production could be made up by other mines. However, the customer would probably have to pay a slightly higher delivery price for coal from another source. The customer currently pays a delivered price of $23.52 per ton for coal purchased from the Big Sky Mine Area A under contract and $19.21 per ton for spot purchases not covered by the long-term contract (Energy Daily 1988).

The Big Sky Area A Mine paid $123,000 in property taxes and $1.1 million in gross proceeds tax in 1987 (J. Lunan, pers. comm., 1988). If the Area A Mine were to close after 1990, the gross proceeds tax payments would cease and property tax payments would decrease dramatically as equipment and improvements were removed or scrapped. No Federal royalties, severance tax, or Resource Indemnity Tax would be paid after 1990.

Peabody coal miners would be laid off or transferred to other Peabody facilities. Some of the workers may remain in the area, but most would leave. This out-migration would reduce the local property tax base and the demand for local services. School enrollment would decline, reducing school expenditures and State payments. Expenditures would not decline in proportion to the decrease in enrollment because of fixed costs for items such as building maintenance and debt repayment.

Conclusion

DSL and OSMRE conclude that fiscal impacts under Alternatives 1, 2, and 3 would be minor. Impacts under Alternative 4 would be significant to Rosebud County.

EMPLOYMENT

Impacts Common to Alternatives 1, 2, and 3

Rosebud County

Granting of the approvals would allow the Big Sky Mine to continue contributing to the area economy. The county would continue to benefit from the 113 basic jobs and annual payroll of about $4 million.

If Peabody mines and markets the additional 1.2 million tons of coal beyond the requested permit (i.e., 4 million tons), basic employment in the county and reservation would increase by about 15 jobs. Basic income would increase by about $400,000 per year (G. Melvin, pers. comm., 1988).

Continued mine operation at current levels of employment would contribute to slow expansion of commercial businesses in Colstrip. Should the Big Sky Mine expand production, results from the DSL Workers Survey (1986b) indicate that most of the 15 additional employees would probably reside in Colstrip and contribute to the economic base of this community.

Northern Cheyenne Indian Reservation

A small portion of the income earned by reservation residents is spent at on-reservation businesses (Feeney et al. 1988, U.S. Department of the Interior 1988). Operation of the Area B Mine would perpetuate what on-reservation expenditures are being made by the 10 Native American mine employees. Due to the existing union contracts, none of the 15 new jobs anticipated under the production expansion scenario would be expected to be filled by Northern Cheyenne tribal members.

Impacts Unique to Alternative 4

Rosebud County

If the approvals are denied, the Big Sky Area A Mine would run out of minable coal and close. The loss of basic jobs and income would reduce the ability of the Rosebud County economy to support present levels of secondary-sector business and public service development.

Mine closure would have the greatest adverse effects on the local economy of Forsyth. The loss of 63 mining jobs for Forsyth residents also

would result in reduced secondary business activity and could contribute to business closures in this community. If the mine closes, the loss of expenditures by Colstrip residents would reduce commercial growth in this community.

Northern Cheyenne Indian Reservation

Mine closure would eliminate high-paying jobs for 10 Native Americans. The loss of mining jobs to reservation area residents would reduce business volume and could also reduce employment at commercial businesses located on the reservation.

Cumulative Impacts

Rosebud County

The coal resources of southeastern Montana could support additional mines. Over the last few years, four additional projects have been proposed or permitted for development--the Montco Mine, the Wolf Mountain Mine, the CX Ranch Mine, and the Greenleaf-Miller Mine (table IV-6) (L. Cabe, pers. comm., 1988). Because economic effects of these mining projects could affect areas of Rosebud County and the Northern Cheyenne Reservation, they have potential to cause cumulative impacts. The Tongue River Railroad also could create new jobs in the area.

If any of these proposed projects were developed, the economic base of Rosebud County would expand. If all of the proposed projects were developed, large-scale expansion of the Rosebud County economy would occur.

Employment projections have been developed for Rosebud County assuming the new mines and the railroad would be in full operation by 1995 (table IV-7). These projections assume that two-thirds of the persons hired by the mining and railroad operations (527 workers) would choose to live in Rosebud County and that employment at the Big Sky Mine would remain at current levels through 2015.

The proposed mining and railroad projects would increase total employment in Rosebud County by about 18 percent by the mid-1990s. New settlement in the county would be greatest in the communities of Ashland and Colstrip. Ashland would experience major growth in new business development and Colstrip would experience more rapid development of its commercial sector than would otherwise occur.

Northern Cheyenne Indian Reservation

The combined effects of the four proposed mines and the railroad project on the economy of the Northern Cheyenne Reservation would depend on the number of Northern Cheyenne hired. Assuming no formal employment agreements

Table IV-6: Proposed Coal Mining and Related Projects in Vicinity of Rosebud County and the Northern Cheyenne Reservation

Project	Annual Production (Tons/Year)	Tentative Construction Date	Tentative Operations Date	Peak Operations Employment
Montco Coal Mine	6	1990	1992	199
CX Ranch Coal Mine	8	1991	1993	265
Wolf Mountain Coal Mine	4	1994	1996	132
Greenleaf-Miller Coal Mine	4	1993	1995	132
Tongue River Railroad	NA	1991	1992	58

Source: U.S. Department of the Interior, Bureau of Land Management 1988.

Table IV-7: Employment Projections With Development of Proposed Coal Mines and Tongue River Railroad, Rosebud County, 1986-2015

Year	Total Employment
1986	5,449
1990	5,038
1995	5,984
2000	6,023
2005	6,064
2010	6,105
2015	6,149

are negotiated for the new mines and railroad, Native Americans are projected to fill 31 of the predicted 786 long-term jobs that would be created by the new mines and railroad.

Secondary employment effects of new energy development on the reservation would be slight (about three to six additional full-time equivalent jobs at on-reservation commercial businesses). Even a large increase in the number of mining and railroad jobs filled by Native Americans would have minor effects on employment in secondary businesses on the reservation. Until changes are made in the marketing of goods and services on the reservation, a large portion of the income of reservation residents would continue to be spent elsewhere, limiting generation of secondary jobs and income for reservation residents.

The prospect of employment would likely motivate return migration of Northern Cheyenne to the reservation, which would increase the reservation labor force. This in-migration could increase unemployment on the reservation.

Conclusion

DSL and OSMRE conclude that impacts to employment under Alternatives 1, 2, and 3, including the production expansion scenario, would be minor. Impacts under Alternative 4 have the potential to become significant.

INCOME

The total (inflation-adjusted) income of Rosebud County residents is projected to decrease through 1990, irrespective of the operation of the Big Sky Mine. Real per capita income for county residents also is projected to decrease gradually. This decrease would occur because most new jobs in the county are projected to be in the lower paying trade and service sectors, rather than in the higher paying electrical generation and mining sectors. Continued trends for rapid population growth and high unemployment among the Northern Cheyenne living in Rosebud County also contribute to the projected decrease in average incomes for county residents.

Impacts Common to Alternatives 1, 2, and 3

Rosebud County

The continued operation of the mine at existing employment levels would help to reduce the ongoing economic slowdown of the county. If the mine continues to operate at existing employment and payroll levels, personal income of county residents in 1990 would be about 6 percent higher than current levels. The 15 additional mining jobs under the production expansion scenario would increase total income for county residents above current levels.

Northern Cheyenne Indian Reservation

If the mine continues to operate at the existing employment level, $300,000 in annual income earned by Native American mine employees would remain in the reservation economy. The related income earned by secondary businesses and their employees would also remain in the economy. Increased employment under the production expansion scenario would not be expected to affect income characteristics on the reservation.

Continued mine operation would help sustain per capita income levels for Native Americans. However, per capita income for reservation residents is misleading because of the vast disparity between the income of Native Americans working in the energy industry and the income of most other Native Americans. To the extent that the Northern Cheyenne employed by Peabody practice income-sharing with their extended families, continued mine operation would benefit the income levels of other reservation residents.

Impacts Unique to Alternative 4

Rosebud County

Should the Big Sky Area A Mine close, the loss of high-paying jobs in coal mining would decrease personal earnings by county residents in 1990 by an estimated $6 million.

Northern Cheyenne Indian Reservation

Closure of the Big Sky Area A Mine would adversely affect the incomes of the 10 Native Americans working there. To the extent that these mine employee households practice income-sharing, incomes of extended family members also would be adversely affected. Mine closure also would have adverse effects on the earnings of persons working in secondary business on the reservation. Mine closure could increase the incidence of poverty on the reservation.

Cumulative Impacts

Rosebud County

As previously described, four additional coal mines and the Tongue River Railroad could be developed in the study area. The projects would create many high-paying jobs and substantially increase total personal income and per capita income for county residents.

Northern Cheyenne Indian Reservation

Development of the potential mining and railroad projects could substantially improve the incomes of Native Americans working directly for the energy companies and slightly improve the incomes of persons working at on-reservation businesses. To the extent that the new miner and secondary worker households practice income-sharing with their extended families, the incomes of other Cheyenne would also benefit from the increased employment.

Conclusion

DSL and OSMRE conclude that impacts to income under Alternatives 1, 2, and 3, including the production expansion scenario, would be minor. Impacts under Alternative 4 would have the potential to become significant.

POPULATION

Impacts Common to Alternatives 1, 2, and 3

Rosebud County

Continued operation of the Big Sky Mine would help sustain the population in Rosebud County. If the mine continues to operate at existing levels of employment, the county is still projected to lose 556 people between 1986 and 1990 (table IV-8). Should mine production increase under the production expansion scenario and employment expand by 15 workers, the short-term population losses projected for the county would be reduced.

New mine workers could be expected to be former Peabody employees from out of state because of the labor agreement between Peabody and the International Union of United Mine Workers. Most of the additional mine employees would likely choose to live in the Colstrip area, since that's where most current mine employees hired from out of state have chosen to reside (Montana Department of State Lands Workers Survey 1986b).

Continued operation of the Big Sky Mine would have minor effects on the Indian and non-Indian composition of the Rosebud County population. The non-Indian population of the county is projected to decrease through the end of the 1980s, even if the mine stays in operation. Out-migration of non-Indians would be less if the mine were to continue to operate at existing or slightly expanded employment levels (table IV-8).

Northern Cheyenne Indian Reservation

Continued operation of the Big Sky Mine at existing or slightly expanded levels of employment is not projected to affect the Native American population living in Rosebud County or on the Northern Cheyenne Reservation (table IV-9). This projection assumes that new jobs at the mine would be

Table IV-8: Population Projections, Indians and Non-Indians, Rosebud County, 1986-2015

	Scenario 1			Scenario 2			Scenario 3		
Year	Indians	Non-Indians	Total	Indians	Non-Indians	Total	Indians	Non-Indians	Total
1986	2,672	8,890	11,562	2,672	8,890	11,562	2,672	8,890	11,562
1990	2,855	8,151	11,006	2,855	8,198	11,053	2,830	7,798	10,628
1995	3,101	8,211	11,312	3,101	8,258	11,359	3,074	7,856	10,930
2000	3,368	8,273	11,641	3,368	8,321	11,689	3,339	7,915	11,254
2005	3,658	8,337	11,995	3,658	8,385	12,043	3,626	7,977	11,603
2010	3,973	8,404	12,377	3,973	8,452	12,425	3,939	8,041	11,980
2015	4,316	8,472	12,788	4,316	8,521	12,837	4,278	8,107	12,385

Table IV-9: Population Projections, Indians and Non-Indians, Northern Cheyenne Reservation, 1986-2015

	Scenario 1			Scenario 2			Scenario 3		
Year	Indians	Non-Indians	Total	Indians	Non-Indians	Total	Indians	Non-Indians	Total
1986	3,806	565	4,371	3,806	565	4,371	3,806	565	4,371
1990	4,067	522	4,589	4,067	525	4,592	4,042	499	4,541
1995	4,417	526	4,943	4,417	529	4,946	4,390	503	4,893
2000	4,797	529	5,326	4,797	533	5,330	4,768	507	5,275
2005	5,211	534	5,745	5,211	537	5,748	5,179	511	5,690
2010	5,660	538	6,198	5,660	541	6,201	5,625	515	6,140
2015	6,147	542	6,689	6,147	545	6,692	6,109	519	6,628

filled by laid-off Peabody employees from out of state. It is possible that some of the new mine employees would be Native Americans from elsewhere in the western United States (e.g., Arizonans who have chosen to live on the Northern Cheyenne Reservation).

Impacts Unique to Alternative 4

Rosebud County

In the event that the mine discontinues operation, the 1990 population in Rosebud County is projected to be 3.5 percent less than if the mine continues to operate at its existing level of employment. With over half of Peabody's employees living in or near Forsyth, effects of mine closure would be felt most strongly in this community. The Forsyth area would lose an estimated 200 to 250 people as a result of not granting the approvals. The Colstrip area would lose between 100 to 150 people as a result of mine closure.

Closure of the Big Sky Mine would likely result in the out-migration of both non-Indians and Indians from Rosebud County. The non-Indian population of Rosebud County is projected to decrease by an additional 4.5 percent in 1990. Out-migration in the late 1980s is projected to lessen the long-term population increases of non-Indians and Native Americans by reducing natural population growth.

Northern Cheyenne Indian Reservation

If the Big Sky Mine were to close, half of the Native Americans working for Peabody would likely leave the reservation area (Montana Department of State Lands Workers Survey 1986b). Irrespective of whether the mine closes, the reservation population would grow substantially in ensuing decades.

Out-migration resulting from mine closure is projected to reduce the Native American population on the reservation by about 0.5 percent in 1990. The out-migration would not be large enough to have notable effects on ongoing demographic trends on the reservation.

Cumulative Impacts

Other potential energy developments could change the population of Rosebud County and the Northern Cheyenne Reservation. The proposed Montco, CX Ranch, Wolf Mountain, and Greenleaf-Miller coal mines and the Tongue River Railroad could result in in-migration.

Rosebud County

Projected cumulative impacts on the area's population (table IV-10) assume that four mines and the railroad would be developed by 1995; that two-thirds of the mine and railroad employees would choose to live in Rosebud County; and that the Big Sky Mine would continue to operate at existing levels of employment. Given these conditions, the population of Rosebud County would increase by about 1,900 people by 1995.

Table IV-10: Population Projections, Non-Indians and Indians, With Development of Proposed Coal Mines and Tongue River Railroad, Rosebud County, 1986-2015

Year	Non-Indians	Indians	Total
1986	8,890	2,672	11,562
1990	8,150	2,855	11,005
1995	9,854	3,359	13,213
2000	9,924	3,649	13,573
2005	9,997	3,963	13,960
2010	10,072	4,304	14,376
2015	10,149	4,675	14,824

Population growth would mainly be attributable to the in-migration of non-Indians to southern Rosebud County. The in-migration would change the proportions of the Indian and non-Indian populations of Rosebud County (table IV-10). Many of the initial in-migrants would likely be young adults attracted to the area by the high-paying jobs in mining.

Ashland, located near several of the proposed projects, would probably receive many of the newcomers. Colstrip also would likely experience substantial new settlement as a result of the mines and railroad.

Northern Cheyenne Indian Reservation

Job opportunities resulting from the development of the proposed coal mines and railroad would motivate some Northern Cheyenne to return to the reservation. This return migration would increase the population by about 185 during the early years of mine operations. Once economies begin to stabilize, out-migration of tribal members would probably resume (table IV-11). Populations of non-Indians and non-Cheyenne Indians living on the reservation could also increase.

Conclusion

DSL and OSMRE conclude that population impacts under Alternatives 1, 2, and 3, including the production expansion scenario, would be minor. Impacts under Alternative 4 would have the potential to become significant.

Table IV-11: Population Projections With Development of Proposed Coal Mines and Tongue River Railroad, Northern Cheyenne Reservation, 1986-2015

Year	Indians	Non-Indians	Total Population
1986	3,806	565	4,371
1990	4,067	522	4,588
1995	4,785	631	5,416
2000	5,197	635	5,832
2005	5,645	640	6,285
2010	6,131	645	6,776
2015	6,659	650	7,309

SOCIAL LIFE

Impacts Common to Alternatives 1, 2, and 3

Rosebud County

Continued operation of the Big Sky Mine at existing levels of employment would perpetuate the current influence of the mine on area social conditions. Should the mine expand production and increase employment (production expansion scenario), the small population increase attributable to the new jobs would counterbalance some of the effects of ongoing out-migration. Most of the new employees would be expected to reside in the Colstrip area. Because the community has experienced population fluctuations and social changes with other energy-related developments, in-migration of the new miners would have little effect on the community.

Northern Cheyenne Indian Reservation

The mine expansion would not be expected to increase employment among the Northern Cheyenne, and therefore would not reduce the incidence of poverty or poverty-related social problems on the reservation. To the extent that operation of the mine contributes to influences of the non-Cheyenne cultural on the Northern Cheyenne, mine expansion would perpetuate this influence. The mine operation would help to maintain the sizable non-Cheyenne population living in the vicinity of the reservation.

Mining of Area B could harm the cultural value of the area to the Northern Cheyenne. They believe that mining would diminish the natural and spiritual qualities of the environment.

Impacts Unique to Alternative 4

Rosebud County

The social effects of mine closure would be greatest for the mine employees and their families. The loss of high-paying jobs and the possible need to move elsewhere would be disruptive to the standard of living and life-style of laid-off workers and their families. Reduced secondary business activity could also result in lost jobs and lower incomes. Because the majority of Peabody employees live in the Forsyth area, social circumstances in this community would be most strongly affected by closure of the mine.

Northern Cheyenne Indian Reservation

The loss of high-paying mining jobs for Native Americans could further add to poverty and poverty-related social problems on the reservation. Because unemployment and poverty are serious problems for Native Americans, any loss of income would adversely affect the reservation population.

Mine closure could reduce the influences of the non-Cheyenne culture on the Northern Cheyenne by prompting out-migration of non-Indians living near the reservation. Should the Area B expansion not take place, the cultural values that the Northern Cheyenne attribute to the natural and spiritual characteristics of the area would not be diminished.

Cumulative Impacts

Rosebud County

The sizable in-migration to Rosebud County resulting from proposed additional mining and railroad projects would result in substantial changes in the social characteristics of southern Rosebud County. The community of Ashland would change from a small ranching and reservation-oriented community to a mining/industrial-oriented area.

Northern Cheyenne Indian Reservation

Development of the four proposed additional mines and the railroad could have major social and cultural impacts on the Northern Cheyenne. In-migration of non-Indians would serve to further increase the influences of non-Cheyenne cultures on the reservation. In particular, major new non-Indian settlement in the Ashland area would affect Cheyenne living in the eastern and north-central portions of the reservation.

Land areas located to the east of the reservation are of particular cultural significance to the Northern Cheyenne. The proposed Montco Mine and Tongue River Railroad could disturb the cultural value of some of these areas for the Northern Cheyenne. These projects also could kindle disagreements between the Northern Cheyenne favoring economic development and those concerned about preserving the Northern Cheyenne culture.

Conclusion

DSL and OSMRE conclude that impacts to social life in Rosebud County under Alternatives 1, 2, and 3, including the production expansion scenario, would be minor. Impacts under Alternative 4 would have the potential to become significant. Impacts to the Northern Cheyenne social life under Alternatives 1, 2, and 3, including the production expansion scenario, would be moderate. Impacts under Alternative 4 would be minor.

LAND USE

Impacts Common to Alternatives 1, 2, and 3

Proposed coal extraction in Area B would disturb approximately 3,200 acres over the 23-year permit and post-permit periods. This acreage would be reclaimed in blocks over a 34-year period. Livestock grazing, the dominant premining land use, would be precluded on disturbed acreage until at least 2 years following reseeding. Table IV-12 shows the number of acres disturbed and graded in each year of the permit period and in 5-year blocks for the post-permit and after-mining periods.

In calculating the amount of land removed from livestock grazing, several assumptions were made: first, it was assumed that the proposed permit area acreage outside the disturbance areas would be fenced and remain available for grazing; second, that all of the acres graded in a given year would be scheduled for soil replacement and seeding no later than the following year; and finally, that livestock grazing would not take place in revegetated areas until grass seedlings were well established and could sustain managed grazing. Although these areas would be able to sustain grazing 2 years after seeding, grazing could not be efficiently implemented until a sizable management unit is available and improved with fencing and stock water facilities. Therefore, most areas would have grasses established for more than 2 years before grazing occurred (Peabody Coal Company 1987a).

Although some short-duration grazing may occur on specific areas to remove accumulated litter, regular grazing would not begin on an area until there are at least 320 contiguous acres with established grasses, cross fencing, and stock water. From table IV-12 it is apparent that approximately 330 acres would be regraded by the end of 1994. Given 1 year for reseeding and 2 additional years for grasses to become established, grazing could resume on this block by spring of 1998 if the necessary range improvements were installed. Likewise, the 547 acres regraded by the end of 1999 would be available for grazing in 2003.

Table IV-12: Projected Reclamation Schedule, Big Sky Mine Area B

Period	Land Disturbed (acres)	Land Graded (acres)
Initial Years of the Permit Period		
1987	397.0	0.0
1990	143.5	14.3
1991	60.0	78.8
1992	53.7	86.0
1993	173.2	56.8
1994	124.0	94.3
Permit Period (5-year increments)	951.4	330.2
1995-1999	559.7	547.5
2000-2004	521.2	586.2
2005-2009	678.8	448.2
2010-2012	446.3	389.4
Post Permit Period	2,242.0	1,971.3
2013	-	169.8
2014	-	66.1
2018	-	212.1
2023	-	111.6
2024	-	338.9
After Mining Totals	-	898.5
TOTAL	3,200.0	3,200.0

Source: Peabody Coal Company 1987a.

Four cattle operators who presently lease grazing lands in the project area have three choices: they may make up for the reduction in acreage by leasing other lands; they may reduce the size of their herds; or they may shift to a more intensive rotation plan on other lands that they lease or own. Because economical grazing land in Rosebud and Treasure counties is scarce, the latter two options are most likely to be exercised by the four existing lessees (D. Myren, pers. comm., 1988).

There would be some changes in the structure and distribution of grasslands in the proposed permit area following mining and reclamation, most notably an increase in grassland acreage and a decrease in sidehill and breaks types that are less accessible to cattle. It is also likely that the flush of fresh plant growth in the initial years after revegetation would be more productive and palatable to cattle than existing vegetation. These benefits would be partially offset by the decreased amounts of warm-season grasses, which are difficult to reestablish. A reduction in warm-season grasses may make reclaimed areas somewhat less productive as late summer and fall rangeland.

Impacts Unique to Alternative 1

Approximately 13 wells, 11 ponds, and 3 springs would be removed or possibly rendered non-functional by proposed mining in Area B. Although replacement of some of the wells is proposed, it is not likely that postmining sources of stock water would be as numerous or well distributed. A decrease in the number of stock water sources could reduce dispersal of livestock and cause uneven and less efficient use of some grassland areas.

Impacts Unique to Alternative 2

Functional stock wells destroyed by mining would be replaced. These sources would be supplemented by ponds or other maintenance-free water sources to provide sufficient water to support premining levels of use by livestock.

Impacts Unique to Alternative 3

Proposed mining in Section 36 would remove an additional 34 acres from livestock grazing, probably during the years 2005-2009. This acreage could be available for grazing by the year 2013.

Impacts Unique to Alternative 4

No impacts or changes in existing land use patterns in the project area would be attributable to permit denial.

Cumulative Impacts

Development of the four additional local coal mines would preclude livestock grazing on those areas. With alternative grazing lands already difficult to lease in Rosebud and Treasure counties, livestock operators may choose to reduce herd size or shift to more intensive grazing rotations on lands they now lease or own.

Conclusion

DSL and OSMRE conclude that impacts to land use under Alternative 1 would be moderate. Impacts under Alternatives 2 and 3 would be minor. There would be no impacts under Alternative 4.

TRANSPORTATION

Impacts Common to Alternatives 1, 2, and 3

No transportation impacts would result from proposed coal development in Area B because existing levels of use on Montana Highway 39 and the Big Sky Mine rail spur would continue.

Impacts Unique to Alterative 4

Upon cessation of Peabody operations in Area A, 63 employees living in Forsyth, 28 employees living in Colstrip, and 10 employees living on the Northern Cheyenne Reservation would no longer commute to the mine on Montana Highway 39. Average daily vehicle (ADV) use would be reduced by about 8 percent between Forsyth and Colstrip, and by an unknown amount between Colstrip and the Big Sky Area A Mine. ADV use between the mine and the reservation also would decrease. Since no unit trains would utilize the rail spur, the once-daily delay caused by the coal unit train at the spur crossing on Montana Highway 39 would cease.

Cumulative Impacts

Development of four possible coal mines and a railroad transport system would result in a work force increase. Some of the persons who would fill these jobs would commute to the mines from Forsyth, Colstrip, and Ashland. Commuting would increase vehicle use on Montana Highway 39 by an unknown amount.

The reservation would experience a population increase due to primary employment from the coal mines. Some of these workers would commute on Montana Highway 39 between the reservation and the Greenleaf-Miller and Wolf Mountain mines, increasing the ADV use by an unknown amount.

Conclusion

DSL and OSMRE conclude that there would be minor impacts to transportation under Alternatives 1, 2, and 3. Impacts under Alternative 4 would be moderate and positive.

CULTURAL RESOURCES

Impacts Common to Alternatives 1, 2, and 3

Proposed mining activities would eventually destroy six archaeological sites deemed eligible for listing in the National Register of Historic Places, and would likely have adverse effects on two other sites. The sites that would be directly destroyed by mining would include: 24RB1145, 24RB1153, 24RB1164, 24RB1171, 24RB1176, and 24RB1181. Table III-22 (Chapter III) lists the dates that these sites would be disturbed. Site 24RB1150 is located approximately 100 feet northwest and 10 feet upslope from the proposed disturbance limit. However, associated mining activities (blasting, soil stockpiling, powerlines, highwall reduction) may eventually disturb or destroy the site. Site 24RB1185 is located 300 feet west and 150 feet upslope from the proposed disturbance limit. Its remote location in steep terrain reduces the potential of impact due to proposed mine activities; however, indirect effects of proposed blasting and highwall reduction may disturb this site to some degree. Site 24RB1163 also would be destroyed. This site may be eligible for listing in the National Register of Historic Places.

At all cultural sites, increased activity due to mine expansion could increase vandalism and souvenir collecting, indirectly affecting the integrity of sites and limiting their value in interpreting and understanding the past. No known fossils of scientific importance would be lost as a result of mine expansion. Discovery of important fossils as a result of proposed mining is a possibility, although the probability is believed to be low.

Impacts Unique to Alternative 1

The proposed alternative would have the greatest impact on sites eligible for listing in the National Register of Historic Places since no plans have been proposed for collection of information at any of the affected sites.

Impacts Unique to Alternatives 2 and 3

Mitigation proposed to recover information at each of the affected sites would reduce impacts to an acceptable level.

Impacts Unique to Alternative 4

Denial of the mine expansion would preserve archaeological sites within and adjacent to the mined area.

Cumulative Impacts

The destruction of archaeological and historical sites due to past, present, and future mining in the Colstrip area results in a loss of data potentially valuable in the interpretation of events important to understanding the cultural history of the region. This loss is, however, mitigated by the collection of information at the eligible sites and the thorough recordation of others. There is positive benefit from the collection of data which otherwise would not have been obtained.

Potential negative impacts of the data collection and recordation efforts relate to the fact that the sites are considered eligible, and data will be collected under today's standards of data recovery and research goals. It is likely that, in the future, new techniques and research goals may be developed and the data collected today would not be applicable to them or that sites not considered eligible today would be in the future. This is a continuing trend in archaeology and is seen as an argument for preservation of sites for the future. In addition, it is possible that not all sites in the area have been located and some sites may be destroyed or damaged without being documented.

Conclusion

DSL and OSMRE conclude that there would be moderate impacts to cultural resources under Alternative 1. Impacts would be minor under Alternatives 2 and 3. There would be no impacts under Alternative 4.

AESTHETICS

Impacts Common to Alternatives 1, 2, and 3

The proposed project would disturb approximately 3,200 acres over the 23-year life of the mine. Existing topography and vegetation within the disturbance area would be incrementally destroyed as mining proceeds. Proposed reclamation and revegetation would gradually restore premining conditions, although topography would be gentler and vegetation less diverse. Loss of several premining land cover types, including clinker and clay breaks, sandstone outcrops, and cultivated grains and pasture, would contribute to a less visually diverse landscape after mining.

Mining activity within the proposed permit area would not be visible from Montana Highway 39 east of the project location, since hills surrounding Lee Coulee screen the project from view. Highway travelers may have occasional glimpses of the proposed haul road where it crosses the ridge between Miller and Lee coulees, but views would be distant (more than 3 miles) and of short duration. No residences are present within 1 mile of the permit boundary. Any potential visibility impacts resulting from views from higher elevations on the Northern Cheyenne Indian Reservation would be minor due to the distances involved.

Long-term visual impacts of the project would be reduced following successful reclamation and revegetation. Visual diversity would be reduced from premining conditions.

Drilling, blasting, haul trucks, and other mining activity would contribute to increased noise levels over the life of the proposed project. Noise levels within the proposed permit area would increase over premining levels. Because residences and non-mining personnel are absent from the immediate area, impacts would be negligible.

Impacts Unique to Alternative 1

Postmining vegetation types would be visually less diverse with this alternative. Postmining needle-and-thread grassland acreage would increase approximately 2 1/2 times, while ponderosa pine vegetation types would decrease to one-tenth of their premining acreage. Other vegetation types would remain at roughly premining levels.

Impacts Common to Alternatives 2 and 3

Postmining vegetation types would closely approximate premining conditions with these alternatives, creating a more visually diverse landscape. Acreage of ponderosa pine types would approximate that present prior to mining. Needle-and-thread grassland acreage would increase to about twice that of premining acreage.

Impacts Unique to Alternative 3

Approximately 34 additional acres would be disturbed by mining in and adjacent to Section 36. This additional disturbance area would not result in an increase in visual impact.

Impacts Unique to Alternative 4

Denial of the approvals would maintain the existing visual character of the area. The rural landscape likely would continue to undergo minor modifications associated with ranching. Overall, mining-related noise in the area would be reduced.

Cumulative Impacts

Mine development and subsequent reclamation would subtly change the visual character of the regional landscape from rugged, natural topography to less pronounced topographic relief and less diverse vegetation cover.

Conclusion

DSL and OSMRE conclude that impacts to aesthetics would be minor under Alternatives 1, 2, and 3. There would be no impacts under Alternative 4.

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY OF THE LANDS AFFECTED BY PROPOSED MINING

Coal from Area B would produce electricity and considerable tax revenues, royalties, and jobs. These benefits would continue throughout the life of the operation at a short-term cost of soils, wildlife, vegetation, and livestock productivity.

Mining would not decrease the long-term productivity of the soils nor the value of the land for recreation, scenery, or livestock production. Nor would mining decrease long-term surface water quality or quantity or ground water supplies. Ground water quality, however, would decrease. Affected waters would be suitable for livestock and wildlife watering.

Over both the short- and long-term (5 or more years), the rangeland productivity of the reclaimed mined land probably would exceed premining levels. However, species diversity and the complex premining vegetation mosaic would be lost for decades.

In the short-term, wildlife on Area B would be disrupted or destroyed. As displaced animals move into adjacent habitats, competition would increase. Some species with small home ranges could use some sites not yet stripped of vegetation and would return quickly to reclaimed areas.

Over the 23-year life of Area B (short-term), Peabody would pay millions of dollars in taxes. These taxes would help finance schools and other State, local, and Federal government expenses.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Peabody proposes to mine 64 million tons of coal over 23 years in Area B. The Rosebud coal seam would be mined, but the McKay seam would not be mined due to coal quality restrictions making it unmarketable. Production rates would average 2.8 million tons per year.

The topography of Area B would be modified during mining, but the final topography would approximate the premining topography and would be suitable for the proposed postmining land use. The existing stratigraphy of the Rosebud overburden would be permanently altered; however, the stratigraphy is not unusual or intrinsically valuable.

Ground water flowing through mine spoils would be of poorer quality than existed prior to mining. Within 100 years of mining, the poorer quality water would reach Rosebud Creek. In periods of low flow, this could reduce

the use of water for irrigation. Flows in two springs could be temporarily reduced. Flow in the upper reach of Lee Coulee could be permanently lost, but would surface farther downstream providing a replacement water source. Three wells would be removed by mining. A one-to-one replacement of water sources would mitigate the loss, but would require maintenance.

During mining, grazing in Area B would be temporarily suspended. Crop production during and after mining would be eliminated unless postmining landowners converted reclaimed rangeland to cropland.

Mining would destroy existing populations of aquatic life, but replacement habitat would eventually allow for redevelopment of similar species.

Thirty-nine known historic and archaeological sites would be destroyed by mining. All sites would be excavated and analyzed before mining, preserving the information contained in the sites.

CHAPTER V:

CONSULTATION AND COORDINATION, PUBLIC PARTICIPATION, AND REVIEW

CONSULTATION AND COORDINATION

In the course of processing Peabody's permit application package for its proposed Big Sky Area B Mine, DSL and OSMRE consulted and coordinated with a variety of agencies.

DFWP (Helena, Montana) was contacted to provide consultation on wildlife matters.

SHPO (Helena, Montana) was contacted regarding the cultural and historic resources in the area.

The Miles City District Office of BLM was contacted to ensure its participation as a cooperating agency for this EIS. As a cooperating agency, the office provided consultation on environmental matters and reviewed the adequacy of the EIS. The office was contacted regarding formal review of the resource recovery and protection plan portion of Peabody's permit application, identification of conditions on the Federal coal leases, determination of postmining land use conflicts, and application of the coal unsuitability criteria.

The Fish and Wildlife Enhancement Office (Helena, Montana), USFWS, was contacted regarding the raptor and fish resources of the area.

The Endangered Species Field Office (Helena, Montana), USFWS, was contacted regarding the Federal threatened and endangered species that could inhabit or otherwise use the proposed Big Sky Area B Mine permit area.

PUBLIC PARTICIPATION

A formal period for submittal of written comments regarding the scope of the EIS analysis occurred from May 2, 1986 through May 30, 1986. DSL and OSMRE published a notice of intent to prepare a draft EIS on the Big Sky Area B Mine proposal, including a request for public participation in determining the scope of the issues to be addressed in that EIS, in the May 2, 1986 Federal Register (51 F.R. 16399). No comment letters on the scope of the EIS analysis were received. There was no interest in public meetings and none were held. Numerous impact topics regarding the applicant's proposal were identified by the agencies during these scoping activities. Many of these topics were evaluated as part of the impact analysis portion of the EIS (Chapter IV).

Commencing with the date of publication of the draft EIS, DSL and OSMRE are opening at least a 60-day period during which they will receive public comments on and review of this draft EIS. Written comments on the draft EIS will be accepted at the DSL address shown on the cover sheet until the date indicated on the insert sheet in the front of this document. The agencies would appreciate receiving written comments as soon as possible.

If substantial interest is shown, DSL and OSMRE may hold a public meeting on the draft EIS during the comment period in Billings, Montana. Expressions of interest in having a public meeting held should be submitted to DSL prior to the date indicated on the insert sheet in the front of this document. If needed, notice of the public meeting will be given in the Federal Register and the Billings Gazette newspaper. Details regarding the public meeting will be provided in the public notice. The agencies strongly urge all persons wishing to comment orally at the public meeting to provide a written copy of their statements.

DSL and OSMRE will issue a final EIS on Peabody's proposed Big Sky Area B Mine that will contain both corrections or clarification of this draft EIS and responses to comments received regarding it. If the draft EIS requires only minor changes, the final EIS may incorporate the draft EIS by reference and include only: (1) a revised and updated summary, (2) necessary revisions to the draft EIS, (3) the agencies' responses to comments on the draft EIS, and (4) the agencies' conclusions and preferred alternative. Therefore, the draft EIS should be retained for possible use with the final EIS.

After DSL and OSMRE publish the final EIS, both the Commissioner, the Division Chief, and the Secretary must make a decision whether to approve or disapprove Peabody's proposals. The State can make this decision no sooner than 15 days following publication of the EIS, OSMRE and the Secretary can make a decision no sooner than 30 days following publication of EPA's Federal Register notice of the availability of the final EIS.

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REVIEW

The draft EIS is available for review in the following places:

Montana Department of State Lands, 1625 11th Avenue, Helena, Montana
Big Horn County Public Library, 419 North Custer Avenue, Hardin, Montana
Miles City Public Library, 1 South 10th, Miles City, Montana
The Rosebud County Library, 201 North 9th Avenue, Forsyth, Montana
Parmly Billings Public Library, 510 North Broadway, Billings, Montana
Sheridan County Fulmer Public Library, 320 N. Brooks, Sheridan, Wyoming
Office of Surface Mining and Reclamation Enforcement, Casper Field Office, 100 East B Street, Federal Building, Room 2128, Casper, Wyoming

Office of Surface Mining and Reclamation Enforcement, Western Field Operations, 1020 15th Street, Brooks Towers, Second Floor, Denver, Colorado
U.S. Department of the Interior, Bureau of Land Management, Powder River Resource Area, Miles City Plaza, Miles City, Montana
U.S. Department of the Interior, Bureau of Land Management, 222 North 32nd Street, Billings, Montana

This EIS has been mailed to all parties that have expressed an interest in it. Additional copies of the document are available upon request from either DSL or OSMRE at the addresses shown on the cover sheet. DSL and OSMRE solicited comments on the EIS from:

<u>U.S. Department of the Interior</u>:
- Bureau of Land Management, Billings, Montana
- Bureau of Land Management, Miles City, Montana
- Bureau of Mines, Denver, Colorado
- Bureau of Mines, Spokane, Washington
- National Park Service, Washington, D.C.
- U.S. Geological Survey, Denver, Colorado
- U.S. Geological Survey, Helena, Montana
- U.S. Geological Survey, Reston, Virginia
- Office of Environmental Project Review, Denver, Colorado
- Office of Environmental Project Review, Washington, D.C.
- Office of the Solicitor, Denver, Colorado
- Office of the Solicitor, Washington, D.C.

<u>Other Federal Agencies</u>:
- U.S. Department of Agriculture:
  - U.S. Forest Service, Billings, Montana
  - U.S. Forest Service, Missoula, Montana
  - U.S. Forest Service, Rapid City, South Dakota
  - U.S. Forest Service, Logan, Utah
  - U.S. Soil Conservation Service, Forsyth, Montana
  - U.S. Soil Conservation Service, Bozeman, Montana
- Bonneville Power Administration, Portland, Oregon
- U.S. Department of Defense:
  - U.S. Air Force, Dallas, Texas
  - U.S. Army Corps of Engineers, Louisville, Kentucky
- Department of Health and Human Services, Denver, Colorado
- Department of Transportation:
  - Federal Highway Administration, Helena, Montana
- Environmental Protection Agency, Denver, Colorado
- Environmental Protection Agency, Helena, Montana
- Environmental Protection Agency, Washington, D.C.
- U.S. Government Printing Office, Laurel, Maryland
- U.S. Government Printing Office, Washington, D.C.

<u>State of Montana</u>:

Bureau of Mines and Geology, Billings, Montana
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Department of Agriculture, Helena, Montana
Department of Commerce - Coal Board, Helena, Montana
Department of Fish, Wildlife & Parks, Helena, Montana
Department of Fish, Wildlife & Parks, Miles City, Montana
Department of Health and Environmental Sciences:
- Air Quality Bureau, Helena, Montana
- Water Quality Bureau, Helena, Montana

Department of Highways, Helena, Montana
Department of Natural Resources:
- Conservation Districts Division, Helena, Montana
- Facility Siting Bureau, Helena, Montana

Department of Revenue:
- Research Bureau, Helena, Montana

Department of State Lands:
- Forestry Division, Missoula, Montana
- Southern Land Office, Billings, Montana

Intergovernmental Review Clearinghouse, Helena, Montana
Montana College of Mineral Science and Technology, Butte, Montana
Montana Environmental Information Center, Helena, Montana
Montana State Auditor, Helena, Montana
Montana State Library, Helena, Montana
Montana State University, Bozeman, Montana
Montana Trade Commission, Helena, Montana
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CHAPTER VI:
APPENDICES

APPENDIX 1

Montana Air Quality Bureau Recommended List of Coal Mining Emission Factors

Emission Source	Emission Amount
Topsoil Removal	16 lb/scraper-hr or 0.38 lb/yd^3
Overburden Drilling	1.5 lb/hole
Overburden Blasting	50 lb/blast x 0.75
Overburden Removal	
a) Dragline	0.04 lb/yd^3 x 0.75
b) Truck/Shovel	0.02 lb/ton x 0.75
c) Scraper	16 lb/scraper-hr
Wind Erosion	E = AIKCL 'V' (Soil loss equation)
Coal Drilling	0.22 lb/hole
Coal Blasting	35 lb/blast x 0.75
Coal Removal	
a) Truck/Shovel	0.003 lb/ton x 0.70
b) Front-end loader	0.003 lb/ton x 0.70
Coal Dumping	0.017 lb/ton x 0.75
Open Storage	1.2 u lb/acre - hr x 0.75 where u = wind speed, m/sec
Primary Crusher	0.02 lb/ton
Secondary Crusher	0.06 lb/ton
Conveyors	0.2 lb/ton
Train Loadout	0.0002 lb/ton
Haul Roads Access Roads	$E = 0.81(s) \frac{S}{30} \frac{365-W}{365}$ .62 lb/vmt
Haul Road Repair	16 lb/scraper, grader-hr

Sources: U.S. Environmental Protection Acency, Region VIII Policy Paper; Wyoming Division of Air Quality.

APPENDIX 2

Average Values and Ranges of Selected Chemical Parameters for Lee Coulee Waterflow at Stations SB0002 (Homestead) and SB0003 (Randy Thomas), Rosebud County, Montana

Site	Period	Parameter	n	Mean	Minimum	Maximum
SB0002 (Homestead)	February-April (Snowmelt)	pH (field)	3	7.78	7.75	7.80
		Fet (mg/l)	3	0.68	0.41	1.13
		Fed (mg/l)	3	0.07	0.05	0.09
		Mnt (mg/l)	3	0.11	0.03	0.21
		TSS (mg/l)	3	34.00	14.00	48.00
		TDS (mg/l)	3	2,650.00	1,350.00	3,370.00
SB0002	May-July (Precipitation)	pH (field)	0	-	-	-
		Fet (mg/l)	0	-	-	-
		Fed (mg/l)	0	-	-	-
		Mnt (mg/l)	0	-	-	-
		TSS (mg/l)	0	-	-	-
		TDS (mg/l)	0	-	-	-
SB0002	August-January (Base Flow)	pH (field)	1	7.30	-	-
		Fet (mg/l)	1	0.17	-	-
		Fed (mg/l)	1	0.12	-	-
		Mnt (mg/l)	1	0.10	-	-
		TSS (mg/l)	1	5.00	-	-
		TDS (mg/l)	1	4,620.00	-	-
SB0003 (Randy Thomas)	February-April (Snowmelt)	pH (field)	4	7.88	7.60	8.10
		Fet (mg/l)	4	0.18	0.11	0.24
		Fed (mg/l)	4	0.09	0.05	0.13
		Mnt (mg/l)	4	0.05	0.01	0.13
		TSS (mg/l)	4	5.00	1.00	10.00
		TDS (mg/l)	4	2,320.00	1,220.00	3,190.00
	May-July (Precipitation)	pH(field)	1	7.80	-	-
		Fet (mg/l)	0	-	-	-
		Fed (,g/l)	1	0.05	-	-
		Mnt (mg/l)	0	-	-	-
		TSS (mg/l)	0	-	-	-
		TDS (mg/l)	1	2,020.00	-	-
	August-January (Base Flow)	pH (field)	3	7.97	7.70	8.10
		Fet (mg/l)	3	0.07	0.06	0.08
		Fed (mg/l)	3	0.05	0.04	0.05
		Mnt (mg/l)	3	0.03	0.02	0.03
		TSS (mg/l)	3	3.00	1.00	6.00
		TDS (mg/l)	3	3,527.00	3,260.00	3,720.00

APPENDIX 3

Average Values and Ranges of Selected Chemical Parameters, Rosebud Creek, Montana

Period	Parameter	Mean	Minimum	Maximum
February-April	ph (field)	8.28	7.50	8.90
	Fe (total) (mg/l)	5.40	0.46	15.00
	Fe (dis) (mg/l)	0.50	0.01	0.21
	Mn (total) (mg/l)	0.21	0.40	0.48
	TSS (mg/l)	199.00	18.00	1,040.00
	TDS (mg/l)	818.00	191.00	1,173.00
May-July (Precipitation)	pH (field)	8.40	7.90	8.60
	Fe (total) (mg/l)	4.72	0.30	16.00
	Fe (dis) (mg/l)	0.30	0.01	0.17
	Mn (total) (mg/l)	0.20	0.02	0.60
	TSS (mg/l)	300.00	30.00	877.00
	TDS (mg/l)	804.00	622.00	1,082.00
August-December (Base Flow)	pH (field)	8.28	7.60	8.60
	Fe (total) (mg/l)	0.54	0.12	1.10
	Fe (dis) (mg/l)	0.04	0.01	0.26
	Mn (total) (mg/l)	0.06	0.02	0.34
	TSS (mg/l)	73.00	18.00	187.00
	TDS (mg/l)	966.00	692.00	1,828.00

APPENDIX 4

Table 4A: Ground Water Quality Statistics Report - Geologic Unit - Ranch Wells

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	25	1,944.96	656.72	1,080	3,400
PH (units)	25	6.98		6.5	8
Water Temperature (DEG C)	25	12.12	2.21	6	16.5
Laboratory Parameters					
Acidity As CACO3 (MG/L)	23	0	0	0	0
Alkalinity as CACO3 (MG/L)	23	420.74	88.27	320	722
Aluminum, Diss. (MG/L)	23	<0.10	0	<0.10	<.10
Bicarbonate (MG/L)	23	513.08	107.6	389.63	879.65
Boron, Diss. (UG/L)	23	210.74	100.77	<100	400
Cadmium, Diss. (UG/L)	23	2.35	1.27	<1	5
Calcium (MG/L)	23	1,13.13	48.28	15	172
Carbonate (MG/L)	23	1.09	2.89	0	9
Chloride (MG/L)	23	9.26	2.83	5	14
Conductivity @25 Deg C (UMHOS/CM)	23	2,143.91	692.48	1,220	3,750
Copper, Diss. (UG/L)	23	<10	0	<10	<10
Fluoride (MG/L)	23	0.37	0.35	0.14	1.81
Iron, Diss. (MG/L)	23	0.73	0.85	<0.03	3.15
Lead, Diss. (UG/L)	23	<10	0	<10	<10
Magnesium (MG/L)	23	1,34.87	73.54	6	254
Manganese, Diss. (MG/l)	23	0.08	0.1	<0.02	0.46
Mercury, Diss. (UG/L)	23	<10	0	<1	<1
Nitrogen, Ammonia (MG/L)	23	0.26	0.2	0.09	0.7
Nitrogen, NO2+NO3 (MG/L)	23	0.2	0.17	<0.05	0.6
Phosphorus, Orthophosphate (MG/L)	23	0.01	0	0.01	0.01
Potassium (MG/L)	23	6.13	3.38	2	17
Selenium, Diss. (UG/L)	23	4.57	2.71	2	12
Sodium (MG/L)	23	247.39	210.4	47	699
SAR	23	6.09	8.57	0.63	32.39
Sulfate (MG/L)	23	910.09	429.46	319	1,900
Vanadium, Diss. (UG/L)	23	<100	0	<100	<100
Zinc, Diss. (MG/L)	23	0.07	0.08	<0.01	0.31
Cations/Anions Balance (%)	23	1.14	0.73	0.18	3.14
Total Disolved Solids @ 180 Deg (MG/L)	23	1,671.35	636.95	855	3,220
Total Dissolved Solids, Calculated (MG/L)	23	1,677.23	629.03	845.73	3,151.27

Table 4B: Ground Water Quality Statistics Report - Geologic Unit - Alluvium

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	75	1,921.24	717.03	640	3,785
PH (units)	75	7.19		6.7	7.7
Water Temperature (DEG C)	75	10.28	1.9	4	19
Depth to Water (FT)	74	15.52	9.26	-1	29.85
Laboratory Parameters					
Acidity As CACO3 (MG/L)	64	0	0	0	0
Alkalinity as CACO3 (MG/L)	64	414.53	80.89	242	577
Aluminum, Diss. (MG/L)	64	<.10	0	<.10	<.10
Bicarbonate (MG/L)	64	505.64	98.68	295.14	703.84
Boron, Diss. (UG/L)	64	209.36	72.05	<100	389
Cadmium, Diss. (UG/L)	64	4.2	3.34	<1	20
Calcium (MG/L)	64	140.98	28.42	66	232
Carbonate (MG/L)	64	0	0	0	0
Chloride (MG/L)	64	10.31	5.74	3	37
Conductivity @25 Deg C (UMHOS/CM)	64	2,103.42	722.39	764	3,800
Copper, Diss. (UG/L)	64	<10	0	<10	<10
Fluoride (MG/L)	64	0.22	0.06	0.12	0.41
Iron, Diss. (MG/L)	64	0.56	1.15	<.03	5.09
Lead, Diss. (UG/L)	64	10.05	0.37	<10	13
Magnesium (MG/L)	64	191.19	81.86	58	370
Manganese, Diss. (MG/l)	64	0.2	0.3	<.02	1.27
Mercury, Diss. (UG/L)	64	<1	0	<1	<1
Nitrogen, Ammonia (MG/L)	64	0.23	0.2	<.10	1.4
Nitrogen, NO2+NO3 (MG/L)	64	1.35	2.69	0.05	11
Phosphorus, Orthophosphate (MG/L)	64	<.01	0.01	<.01	0.04
Potassium (MG/L)	64	6.55	2.61	1	13
Selenium, Diss. (UG/L)	64	7.11	3.15	<2	16
Sodium (MG/L)	64	126.36	81.5	9	338
SAR	64	1.53	0.84	0.19	4.35
Sulfate (MG/L)	64	960.41	488.97	91	2,220
Vanadium, Diss. (UG/L)	64	<100	0	<100	<100
Zinc, Diss. (MG/L)	64	0.02	0.02	0.01	0.08
Cations/Anions Balance (%)	64	0.94	0.57	0	2.09
Total Disolved Solids @ 180 Deg (MG/L)	64	1,762.22	735.66	436	3,630
Total Dissolved Solids, Calculated (MG/L)	64	1,688.25	702.21	436.05	3,497.24

Table 4C: Ground Water Quality Statistics Report - Geologic Unit - Overburden

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	53	1,511.57	1,110.59	500	4,400
PH (units)	51	7.02		6.6	8.3
Water Temperature (DEG C)	53	11.55	2.63	6	20
Depth to Water (FT)	53	62.87	36.09	19.37	186.36
Laboratory Parameters					
Acidity As CACO3 (MG/L)	54	0	0	0	0
Alkalinity as CACO3 (MG/L)	53	480.74	194.49	241	904
Aluminum, Diss. (MG/L)	54	<.10	0.01	<.01	0.2
Bicarbonate (MG/L)	53	586.41	237.27	293	1,102.81
Boron, Diss. (UG/L)	54	139.19	89.69	<100	537
Cadmium, Diss. (UG/L)	54	3.2	2.44	<1	11
Calcium (MG/L)	53	126.25	91.7	17	354
Carbonate (MG/L)	53	0	0	0	0
Chloride (MG/L)	53	9.09	8.76	2	33
Conductivity @25 Deg C (UMHOS/CM)	53	1,591.45	1,093.73	606	4,310
Copper, Diss. (UG/L)	54	<10	0	<10	<10
Fluoride (MG/L)	54	0.28	0.11	0.03	0.64
Iron, Diss. (MG/L)	54	0.22	0.54	0.03	2.4
Lead, Diss. (UG/L)	54	11	3.52	<10	27
Magnesium (MG/L)	53	150.11	135.93	14	504
Manganese, Diss. (MG/l)	54	0.1	0.08	<.02	0.32
Mercury, Diss. (UG/L)	54	<1	0	<1	<1
Nitrogen, Ammonia (MG/L)	54	0.26	0.32	<.10	2
Nitrogen, NO2+NO3 (MG/L)	54	1.4	3.15	<.05	12
Phosphorus, Orthophosphate (MG/L)	54	<.01	0	<.01	0.03
Potassium (MG/L)	53	4.62	2.88	1	13
Selenium, Diss. (UG/L)	54	6.07	2.27	<2	15
Sodium (MG/L)	53	77.28	96.83	10	417
SAR	53	1.32	2.8	0.23	15.7
Sulfate (MG/L)	53	583.66	744.92	70	2,550
Vanadium, Diss. (UG/L)	54	<100	0	<100	<100
Zinc, Diss. (MG/L)	54	0.18	0.47	<.01	2.94
Cations/Anions Balance (%)	53	1.15	0.71	0	2.7
Total Disolved Solids @ 180 Deg (MG/L)	53	1,275.96	1,206.42	356	4,330
Total Dissolved Solids, Calculated (MG/L)	53	1,243.79	1,144.73	348.81	4,212.47

Table 4D: Ground Water Quality Statistics Report - Geologic Unit - Rosebud Coal

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	64	2,510.23	859.03	750	4,631
PH (units)	63	6.93		6.5	8.5
Water Temperature (DEG C)	64	12.09	2.69	5.5	20.5
Depth to Water (FT)	64	87.92	42.82	31	186
Laboratory Parameters					
Acidity As CACO3 (MG/L)	64	0	0	0	0
Alkalinity as CACO3 (MG/L)	63	632.76	131.77	375	873
Aluminum, Diss. (MG/L)	64	0.15	0.39	<.10	3.2
Bicarbonate (MG/L)	63	771.85	160.81	457.39	1,064.97
Boron, Diss. (UG/L)	64	256.25	74.54	<100	400
Cadmium, Diss. (UG/L)	64	4.09	4.63	<1	29
Calcium (MG/L)	63	219.41	122.99	9	522
Carbonate (MG/L)	63	0	0	0	0
Chloride (MG/L)	63	11.21	5.86	5	27
Conductivity @25 Deg C (UMHOS/CM)	63	2,684.76	763.54	920	4,470
Copper, Diss. (UG/L)	64	<10	0	<10	<10
Fluoride (MG/L)	64	0.21	0.17	<0.10	0.82
Iron, Diss. (MG/L)	64	0.33	0.49	<0.03	2.4
Lead, Diss. (UG/L)	64	16.78	47.46	<10	390
Magnesium (MG/L)	63	204.86	114.61	3	440
Manganese, Diss. (MG/l)	64	0.22	0.16	<0.02	0.6
Mercury, Diss. (UG/L)	64	1	0	<1	1
Nitrogen, Ammonia (MG/L)	64	0.84	1	<0.10	7.9
Nitrogen, NO2+NO3 (MG/L)	64	0.08	0.12	<0.05	0.76
Phosphorus, Orthophosphate (MG/L)	64	0.02	0.04	<0.01	0.33
Potassium (MG/L)	63	6.86	2.33	3	13
Selenium, Diss. (UG/L)	64	6.59	3.88	<2	26
Sodium (MG/L)	63	219.89	165.11	59	656
SAR	63	5.07	8.83	0.77	37.66
Sulfate (MG/L)	63	1,199.32	611.36	146	2,610
Vanadium, Diss. (UG/L)	64	<100	0	<100	<100
Zinc, Diss. (MG/L)	64	0.39	1.26	<0.01	8.57
Cations/Anions Balance (%)	63	0.86	0.56	0	1.99
Total Disolved Solids @ 180 Deg (MG/L)	63	2,324.03	955.87	574	4,550
Total Dissolved Solids, Calculated (MG/L)	63	2,246.89	883.69	589.37	4,339.43

Table 4E: Ground Water Quality Statistics Report - Geologic Unit - McKay Coal

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	67	2,763.69	576.37	1750	4,488
PH (units)	66	7.32		6.8	8.5
Water Temperature (DEG C)	67	12.23	2.05	6.5	17
Depth to Water (FT)	67	105.31	47.95	41	213.03
Laboratory Parameters					
Acidity As CACO3 (MG/L)	67	0	0	0	0
Alkalinity as CACO3 (MG/L)	66	478.05	85.42	340	755
Aluminum, Diss. (MG/L)	67	0.14	0.17	<0.10	1.3
Bicarbonate (MG/L)	66	583.05	104.24	414.72	921
Boron, Diss. (UG/L)	67	230.6	112.21	<100	900
Cadmium, Diss. (UG/L)	67	3.21	3.13	<1	13
Calcium (MG/L)	66	153.45	81.91	12	320
Carbonate (MG/L)	66	0.23	1.85	0	15
Chloride (MG/L)	66	10.56	5.31	1	26
Conductivity @25 Deg C (UMHOS/CM)	66	2,957.88	485.26	1,980	4,350
Copper, Diss. (UG/L)	67	<10	0	<10	<10
Fluoride (MG/L)	67	0.33	0.22	<0.10	1
Iron, Diss. (MG/L)	67	0.26	0.44	<0.03	2.04
Lead, Diss. (UG/L)	67	12.6	19.91	<10	173
Magnesium (MG/L)	66	120.26	76.61	5	285
Manganese, Diss. (MG/l)	67	0.13	0.11	<0.02	0.67
Mercury, Diss. (UG/L)	67	<1	0	<1	<1
Nitrogen, Ammonia (MG/L)	67	1.5	0.57	<0.10	2.8
Nitrogen, NO2+NO3 (MG/L)	67	0.08	0.06	<0.05	0.28
Phosphorus, Orthophosphate (MG/L)	67	<0.01	<0.01	<0.01	0.06
Potassium (MG/L)	66	8.88	2.03	4	13
Selenium, Diss. (UG/L)	67	6.9	4.28	<2	22
Sodium (MG/L)	66	445.11	200.52	96	1,020
SAR	66	9.46	8.28	1.21	31.17
Sulfate (MG/L)	66	1,324.95	282.29	799	2,010
Vanadium, Diss. (UG/L)	67	<100	0	<100	<100
Zinc, Diss. (MG/L)	67	0.22	0.65	<0.01	5.07
Cations/Anions Balance (%)	66	0.96	0.63	0	2.46
Total Disolved Solids @ 180 Deg (MG/L)	66	2,375.76	440.74	1,590	3,610
Total Dissolved Solids, Calculated (MG/L)	66	2,354.34	437.18	1,562.8	3,505.79

Table 4F: Ground Water Quality Statistics Report - Geologic Unit - Sub-McKay

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	108	2,573.59	755.58	1,200	4,700
PH (units)	106	7.18		6.7	8.8
Water Temperature (DEG C)	108	11.49	1.92	8	18
Depth to Water (FT)	104	69.47	61.47	12.53	260.8
Laboratory Parameters					
Acidity As CACO3 (MG/L)	99	0	0	0	0
Alkalinity as CACO3 (MG/L)	98	447.84	93.09	270	806
Aluminum, Diss. (MG/L)	99	0.11	0.11	<0.10	1.2
Bicarbonate (MG/L)	98	546.24	113.58	329.31	983.25
Boron, Diss. (UG/L)	99	250.71	88.55	<100	600
Cadmium, Diss. (UG/L)	99	3.79	3.5	<1	17
Calcium (MG/L)	98	151.44	87.13	13	460
Carbonate (MG/L)	98	0	0	0	0
Chloride (MG/L)	98	12.88	7.71	4	46
Conductivity @25 Deg C (UMHOS/CM)	98	2,822.35	690.4	1520	4,580
Copper, Diss. (UG/L)	99	10.07	0.7	<10	17
Fluoride (MG/L)	99	0.32	0.24	<0.10	1.2
Iron, Diss. (MG/L)	99	0.26	0.38	<0.03	1.87
Lead, Diss. (UG/L)	99	10.36	1.68	<10	22
Magnesium (MG/L)	98	170.49	120.9	6	388
Manganese, Diss. (MG/l)	99	0.09	0.08	<0.02	0.45
Mercury, Diss. (UG/L)	99	1	0	1	1
Nitrogen, Ammonia (MG/L)	99	0.8	0.78	<0.01	4.4
Nitrogen, NO2+NO3 (MG/L)	99	0.26	0.4	<0.05	1.78
Phosphorus, Orthophosphate (MG/L)	99	0.03	0.16	0.01	1.64
Potassium (MG/L)	98	8.04	2.19	1	15
Selenium, Diss. (UG/L)	99	6.6	4.76	<2	32
Sodium (MG/L)	98	345.28	216.59	63	1,010
SAR	98	6.91	7.43	0.93	30.74
Sulfate (MG/L)	98	1,339	516.29	610	3,040
Vanadium, Diss. (UG/L)	99	<100	0	<100	<100
Zinc, Diss. (MG/L)	99	0.31	1.4	<0.01	13.1
Cations/Anions Balance (%)	98	1.26	3.22	0	32.1
Total Disolved Solids @ 180 Deg (MG/L)	98	2,343.47	755.41	1,200	4,750
Total Dissolved Solids, Calculated (MG/L)	98	2,299.86	727.37	1,174.37	4,529.24

Table 4G: Ground Water Quality Statistics Report - Geologic Unit - Interburden

Parameter	Observ.	Mean	St. Dev.	Min	Max
Field Parameters					
Conductivity (UMHOS/CM)	56				
PH (units)	55				
Water Temperature (DEG C)	56				
Depth to Water (FT)	56				
Laboratory Parameters					
Acidity As CACO3 (MG/L)	56	0	0	0	0
Alkalinity as CACO3 (MG/L)	55	551.51	150.69	255	827
Aluminum, Diss. (MG/L)	56	0.11	0.05	<0.10	0.3
Bicarbonate (MG/L)	55	672.71	183.83	311.08	1,008
Boron, Diss. (UG/L)	56	276.98	100.28	<100	500
Cadmium, Diss. (UG/L)	56	3.88	3.2	<1	13
Calcium (MG/L)	55	206.38	99.4	22	390
Carbonate (MG/L)	55	0	0	0	0
Chloride (MG/L)	55	11.36	5.84	4	25
Conductivity @25 Deg C (UMHOS/CM)	55	3,062.47	824.15	742	4,290
Copper, Diss. (UG/L)	56	10.18	1.34	<10	20
Fluoride (MG/L)	56	0.23	0.18	<0.10	1.3
Iron, Diss. (MG/L)	56	0.34	0.55	<0.03	1.86
Lead, Diss. (UG/L)	56	10.66	3.94	<10	39
Magnesium (MG/L)	55	201.53	108.15	10	404
Manganese, Diss. (MG/l)	56	0.18	0.16	0.02	0.61
Mercury, Diss. (UG/L)	56	<1	0	<1	<1
Nitrogen, Ammonia (MG/L)	56	1.57	0.83	0.5	4.1
Nitrogen, NO2+NO3 (MG/L)	56	0.07	0.1	<0.05	0.8
Phosphorus, Orthophosphate (MG/L)	56	0.01	0.01	0.01	0.4
Potassium (MG/L)	55	9.87	3.74	1	19
Selenium, Diss. (UG/L)	56	7.29	4.31	<2	20
Sodium (MG/L)	55	339.58	194.87	38	736
SAR	55	5.23	5.48	0.88	30.41
Sulfate (MG/L)	55	1,480.42	520.24	118	2190
Vanadium, Diss. (UG/L)	56	98.21	13.36	0	100
Zinc, Diss. (MG/L)	56	0.31	0.54	<0.01	2.48
Cations/Anions Balance (%)	55	0.86	0.62	0	2.41
Total Disolved Solids @ 180 Deg (MG/L)	55	2,645.78	852.24	422	3,830
Total Dissolved Solids, Calculated (MG/L)	55	2,585.01	813.83	450.44	3,697.54

APPENDIX 5

TDS Calculations

Calculations of increased TDS in Rosebud Creek alluvium due to increased TDS loads from Lee Coulee alluvial flow and Lee Coulee sub-McKay flow.

The approach used in these calculations is described by Peabody Coal Company (1987) on pages 17-25 through 17-32 of the application. These estimates differ from Peabody's in that TDS loading from Lee Coulee alluvium and sub-McKay aquifiers are added to determine TDS concentrations in water of the Rosebud Creek alluvium.

Lee Coulee alluvial flows = .0337 cfs = 24.4 af/yr
Lee Coulee sub-McKay flow = .20 cfs = 144.7 af/yr
Rosebud Creek alluvial flow = .08 cfs = 57.9 af/yr
Postmine TDS load in Lee Coulee alluvium = 141 tons/yr
Postmine TDS load in sub-McKay aquifer in Lee Coulee = 837 tons/yr
TDS load in Rosebud Creek alluvium = 291 tons/yr
.00136 = Conversion factor to change tons/af to mg/l postmine TDS concentration in alluvium of Rosebud Creek:

$$\frac{141\ \text{ton/yr} + 837\ \text{tons/yr} + 291\ \text{tons/yr}}{(24.4\ \text{af/yr} + 144.7\ \text{af/yr} = 57.9\ \text{af/yr}).00136} = 4{,}111\ \text{mg/l}$$

$$\%\ \text{to increase} = \frac{\text{Postmine TDS} - \text{Premine TDS}}{\text{Premine TDS}}$$

$$= \frac{4{,}111\ \text{mg/l} - 3{,}690\ \text{mg/l}}{3{,}690\ \text{mg/l}}$$

$$= 11\%\ \text{TDS increase in Rosebud Creek alluvium}$$

APPENDIX 6

Density of Bottom-Dwelling Macroinvertebrates Collected from Lee Coulee (individuals/square foot)

Taxa	Pond 1 Sampled 6/18/85	Pond 2 Sampled 6/19/85	Pond 3 Sampled 6/19/85
Oligochaeta			
Tubificidae	13	7	
Limnodrilus hoffmeisteri	8	3	
Limnodrilus profundicola	1	3	
Gastropoda			
Physidae			
Physa sp.	2	7	
Gyraulus sp.	19		
Pelecypoda			
Sphaeriidae			
Pisidium sp.	1		
Amphipoda			
Talitridae			
Hyalella azteca	187	7	
Collembola			
Poduridae			
Podura aquatica	*		
Ephemeroptera	5		1
Baetidae			
Callibaetis sp.	*	3	*
Odonata			
Lestidae			
Lestes sp.	2	*	*
Coenagrionidae			
Enallagma sp.			*
Libellulidae			
Libellula sp.	*		
Leucorrhinia intacta		*	
Leucorrhinia borealis			*
Gomphidae			*

Taxa	Pond 1 Sampled 6/18/85	Pond 2 Sampled 6/19/85	Pond 3 Sampled 6/19/85
Hemiptera			
Gerridae			*
Gerris comatus		*	
Gerris sp.			*
Corixidae	*	*	
Hesperocorixa laevigata	1	*	
Sigara decoratella	*	*	
Sigara alternata	*		*
Notonectidae			
Notonecta spinosa		*	*
Notonecta kirbyi	*		
Notonecta sp.	*	*	
Salididae		*	*
Coleoptera			1
Haliplidae		*	
Brychius sp.	7		
Haliplus sp.	*	2	
Peltodytes sp.	*		
Hydrophilidae			
Helophorus sp.	*		*
Enochrus sp.		*	
Tropisternus sp.		*	
Berosus sp.		3	
Dytiscidae			
Laccophilus sp.	2	*	*
Hygrotus sp.	2	2	
Chrysomelidae			
Donacia sp.		*	
Diptera	2	1	5
Heleidae			
Palpomyia stilobezzia	1		
Palpomyia sp.	85	1	67
Culicidae			2
Chaeoborus sp.	*	*	
Aedes sp.			*
Tabanidae			
Tabanus sp.	2	5	
Chrysops sp.		1	*

Taxa	Pond 1 Sampled 6/18/85	Pond 2 Sampled 6/19/85	Pond 3 Sampled 6/19/85
Chironomidae			
Chironomus sp.	1	2	*
Chironomus attenuatus (group)	*	43	1,691
Pseudochironomus sp.	1	1	
Cricotopus sylvestris (group)	18	*	*
Cladotanytarsus sp.	12	*	
Tanypus carinatus	3		8
Labrundinia virescens	1		
Tanytarsus sp.	*		
Psectrotanypus sp.	1	24	
Paratanytarsus sp.	3		16
Rheotanytarsus sp.		1	
Orthocladius sp.			16
Tanytarsini (unknown)	1		
Tanytarsus guerlus		*	
Stempellina sp.		*	
Eukiefferiella sp.		*	
Orthocladiinae (unknown)	*	1	
Tanypodinae (unknown)		1	
Chironominae (unknown)	*		
Arachnida			
Acarina			
Acari	*		
Total Number of Quantitatively Sampled Taxa	24	21	10
Total Number of Taxa	42	41	25
Total Number of Individuals/ Square Foot	378	98	1,831
Shannon-Weaver Diversity Index (d –)	2.44	3.17	.67
Equitability (e)	.31	.61	.18

Source: Peabody Coal Company 1986, Volume 8, Appendix 10-3.

Notes: Blanks indicate that no macroinvertebrates were collected.
*Taxon collected by dip net only. Quantitative estimates not possible.

APPENDIX 7

Macroinvertebrates Collected from Rosebud Creek, 1976

Ephemeroptera
- Baetidae
  - _Baetis_ (near _propinquus_)
- Leptophlebiidae
  - _Choroterpes_ _albiannulata_

Odonata
- Gomphidae
  - _Gomphus_ _externus_
- Libellulidae
  - _Sympetrum_ _occidentale_

Zygoptera
- Coenagrionidae
  - _Argia_ _fumipennis-violacea_
- Calopterygidae
  - _Hetaerina_ _americana_

Hemiptera
- Gerridae
  - _Gerris_ _remiges_
- Veliidae
  - _Rhagovelia_ _distincta_

Trichoptera
- Hydropsychidae
  - _Hydropsyche_ _bronta_
  - _Hydropsyche_ _separata_
  - _Arctopsyche_ sp.
  - _Cheumatopsyche_ _lasia_
  - _Cheumatopsyche_ _analis_
  - _Cheumatopsyche_ _campyla_
- Psychomyiidae
  - _Polycentropus_ _cinereus_
- Leptoceridae
  - _Oecetis_ _avara_
  - _Leptocella_ _albida_
  - _Leptocella_ (near _candida_)
- Brachycentridae
  - _Brachycentrus_ _occidentalis_

Plecoptera
- Nemouridae
  - _Brachyptera_ _fosketti_
- Perlodidae
  - _Isoperla_ _patricia_

Diptera
- Tabanidae
  - _Chrysops_ _proclivis_
- Tipulidae
  - _Tipula_ _vicina_

Source: Baril et al. 1978, p. 27.

APPENDIX 8

Fish Species Collected from Rosebud Creek (1975-1976) and Relative Abundance Near Confluences with Lee Coulee and Cow Creek

Collected Species	Scientific Name	Number Collected Per Mile	
		Lee Coulee	Cow Creek
White Sucker	Catostomus commersoni	24	21
Shorthead Redhorse	Moxostoma macrolepidotum	16	8
Flathead Chub	Hybopsis gracilis	5	5
Lake Chub	Couesius plumbeus	5	-
Northern pike	Esox lucius	3[1]	5[2]
Mountain sucker	Catostomus platyrhynchus	2	-
Carp	Cyprinus carpio	2	-
Goldeye	Hiodon alosoides	-	-
Longnose dace	Rhinichthys cataractae	-	-
Longnose sucker	Catostomus catostomus	-	-
Black bullhead	Ictalurus melas	-	-
Channel catfish	Ictalurus punctatus	-	-
Stonecat	Noturus flavus	-	-
Burbot	Lota lota	-	-
Walleye	Stizostedion vitreum	-	-
Sauger	Stizostedion canadense	-	-

Source: Elser and Schreiber (1978, pp. 15 and 19).

Note: Dashes indicate the species were not collected at these confluences.

[1]Mean weight = 0.31 lbs, mean lenth = 10 inches.
[2]Mean weight = 0.60 lbs, mean length = 12.9 inches.

APPENDIX 9

Topsoil Quantities and Characteristics by Soil Type, Big Sky Mine Area B, Rosebud County, Montana

Soil Type	Area Inside Permit Boundary (Acres)	Area Inside Permit Boundary (Percent)	Affected Area (Acres)	Affected Area (Percent)	Mean Salvage Thickness of Topsoil (Feet) (Lift 1)	Mean Salvage Thickness of Topsoil (Feet) (Lift 2)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 1)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 2)	Topsoil Salvage Limitations
Ustic Torrifluvents 0-4% slopes	273.2	5.0	146.0	4.8	0.5	2.0	73.0	292.0	Gravel and sand lenses, violent effervescence
Typic Fluvaquents 0-4% slopes	64.4	1.2	60.9	2.0	0.0	0.5	0.0	30.5	Shallow ground water, violent effervescence, massive structure, mottles, high EC, moderate SAR
Yamac Silty Clay Loam 0-2% slopes	103.9	1.9	71.6	2.3	0.5	2.0	35.8	143.2	Sand and gravel lenses, violent effervescence, mottles, massive structure, excessive clay
Ustic Torriorthents 6-35% slopes	238.5	4.4	154.1(1)	5.0	0.5	1.5	38.5	115.6	Very steep dissected slopes, sand and gravel lenses, ponderosa pine canopy, violent effervescence, loose consistence, single-grained structure
Lonna Variant Silt Loam 0-6% slopes	58.1	1.1	23.9	0.1	1.0	2.0	23.9	47.8	High sand content, violent effervescence, few roots
Busby Sandy Loam 2-15% slopes	974.8	17.9	824.7	26.9	1.0	1.0	824.7	824.7	High sand content, gravel and shale lenses, loose consistence, violent effervescence, few roots
Cabbart Silt Loam 2-15% slopes	89.3	1.6	88.6	2.9	0.5	0.5	44.3	44.3	Siltstone and shale bedrock, high coarse fragment content, violent effervescence, high EC
Davidell Silt Loam 0-4% slopes	97.5	1.8	59.5	1.9	0.5	1.5	29.7	89.3	High clay content, sand and gravel lenses, high EC, mottles, few roots massive structure, very hard consistence, extremely calcareous

Soil Type	Area Inside Permit Boundary (Acres)	Area Inside Permit Boundary (Percent)	Affected Area (Acres)	Affected Area (Percent)	Mean Salvage Thickness of Topsoil (Feet) (Lift 1)	Mean Salvage Thickness of Topsoil (Feet) (Lift 2)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 1)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 2)	Topsoil Salvage Limitations
Forelle Loam 2-15% slopes	1,017.5	18.7	577.3	18.9	0.5	2.0	288.7	1,154.6	Sand and gravel lenses, massive structure, violent effervescence, few roots
Spang Loam 2-15% slopes	145.5	2.7	88.8	2.9	0.5	1.0	44.4	88.8	Sand and gravel lenses, few roots, very hard consistence, violent effervescence
Rentsac Channery Sandy Loam 2-12% slopes	164.1	3.0	1.9	0.1	0.5	0.0	1.0(2)	0.0	Shallow soil, high coarse fragment content
Armells Very Gravelly Loam 6-25% slopes	256.3	4.7	107.8(1)	3.5	0.5	0.0	27.0(2)	0.0	Steep highly dissected slopes, high coarse fragment content
Birney Channery Sandy Loam 25-70% slopes	414.8	7.6	99.5	3.3	0.0	0.0	0.0(3)	0.0	Very steep highly irregular slopes, high coarse fragment content, ponderosa pine canopy
Birney-Cabbart Complex 25-70% slopes	198.8	3.7	54.3	1.8	0.0	0.0	0.0(3)	0.0	Very steep highly dissected slopes, high coarse fragment content, ponderosa pine canopy
Blackhall-Twilight-Busby Sandy Loams Complex 2-25% slopes	258.8	4.8	131.5	4.3	0.5	0.5	65.7	65.8	Shallow siltstone and sandstone bedrock, sand lenses, high coarse fragment content, loose consistence, violent effervescence
Rentsac-Armells Very Channery Sandy Loams Complex 6-35% slopes	281.8	5.2	170.6(1)	5.6	0.5	0.0	42.7(2)	0.0	Steep highly dissected slopes, shallow soil, high coarse fragment content

Soil Type	Area Inside Permit Boundary (Acres)	Area Inside Permit Boundary (Percent)	Affected Area (Acres)	Affected Area (Percent)	Mean Salvage Thickness of Topsoil (Feet) (Lift 1)	Mean Salvage Thickness of Topsoil (Feet) (Lift 2)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 1)	Mean Salvage Volume of Topsoil (Acre-Feet) (Lift 2)	Topsoil Salvage Limitations
Rock Outcrop-Cabbart-Armells Complex 25-70% slopes	384.1	7.1	44.8	1.5	0.0	0.0	0.0(3)	0.0	Very steep highly dissected slopes, highly coarse fragment content, shallow siltstone and shale bedrock
Rock Outcrop-Blackhall-Twilight Complex 6-35% slopes	124.8	2.3	124.2(1)	4.1	0.5	0.0	31.1(2)	0.0	Steep highly dissected slopes, shallow siltstone and sandstone bedrock, sand lenses, high coarse fragment content
Yetull Loamy Sand 2-15% slopes	100.1	1.8	71.4	2.3	0.5	0.5	35.7	35.7	Very high sand content, single-grained structure, loose consistence
Shale Rock Outcrop	91.3	1.7	85.3	2.8	0.0	0.0	0.0	0.0	Shale bedrock at surface
Sandstone Rock Outcrop	95.1	1.7	77.5	2.5	0.0	0.0	0.0	0.0	Sandstone bedrock at surface
Disturbed Land	---	---	0.0	---	0.0	0.0	0.0	0.0	No in situ soil
Reclaimed Land	2.9	0.1	0.0	---	0.5	1.0	0.0	0.0	Topsoil/spoil interface
TOTAL	5,435.8	100.0	3,064.2	99.5	---	---	1,606.2(4)	2,932.3(5)	

(1) Due to excessively steep and highly dissected slopes in combination with a ponderosa pine canopy, only 50 percent of this unit can be traversed effectively and safely by the salvage equipment.
(2) This soil resource will primarily be utilized, whenever feasible, in postmine ponderosa pine planting areas.
(3) If isolated areas of recoverable topsoil are encountered in these map units, they will be salvaged and primarily utilized, whenever feasible, in the postmine ponderosa pine planting areas.
(4) Lift 1 topsoil replacement depth will be 0.5 feet (1606.2/3064.2).
(5) Lift 2 topsoil replacement depth will be 1.0 feet (2932.3/3064.2).

APPENDIX 10

Common and Scientific Names of Plant Species

Common Name	Scientific Name
Grasses and Grasslike	
Needle-and-thread	Stipa comata
Blue grama	Bouteloua gracilis
Western wheatgrass	Agropyron smithii
Threadleaf sedge	Carex filifolia
Japanese brome	Bromus japonicus
Little bluestem	Schizachyrium scoparium
Bluebunch wheatgrass	Agropyron spicatum
Prairie junegrass	Koeleria cristata
Kentucky bluegrass	Poa pratensis
Green needlegrass	Stipa viridula
Six-weeks fescue	Festuca octoflora
Thickspike wheatgrass	Agropyron dasystachum
Sideoats grama	Bouteloua curtipendula
Sun sedge	Carex pensylvanica
Small needlegrass	Stipa nelsonii
Foxtail barley	Hordeum jubatum
Bulrush	Scirpus spp.
Prairie cordgrass	Spartina pectinata
Nebraska sedge	Carex nebracensis
Common spikesedge	Eleocharis palustris
Slender wheatgrass	Agropyron trachycaulus
Panicgrass	Panicum virgatum
Clustered field sedge	Carex praegracilis
Intermediate wheatgrass	Agropyron intermedium
Wheat	Triticum aestivum
Forbs	
Platte River milkvetch	Astragalus plattensis
Small-flowered evening primrose	Camissonia minor
Prickly poppy	Argemone polyanthemos
Silverleaf scurfpea	Psoralea argophylla
Scarlet globemallow	Sphaeralcea coccinea
Taragon sagewort	Artemisia dracunculus
Creeping white prairie aster	Aster falcatus
Hood's phlox	Phlox hoodii
Purple coneflower	Echinacea angustifolia
Common dandelion	Taraxacum officinale
Common yarrow	Achillea millifolium
Wavyleaf thistle	Cirsium undulatum
Common salsify	Tragopogon dubius

Common Name	Scientific Name
Few-flowered buckwheat	_Eriogonum pauciflorum_
Field chickweed	_Cerastium arvense_
Prairiesmoke	_Geum triflorum_
Prairie milkvetch	_Astragalus striatus_
Smallpod tumblemustard	_Sisymbrium loesellii_
Curdlock	_Rumex crispus_
Stinging nettle	_Urtica dioica_
Horsemint	_Monarda fistulosa_
Stiff goldenrod	_Solidago rigida_
Tufted white prairie aster	_Aster pansus_
Shrubs and Trees	
Big sagebrush	_Artemisia tridentata_
Yucca	_Yucca glauca_
Skunkbush sumac	_Rhus trilobata_
Silver sagebrush	_Artemisia cana_
Ponderosa pine	_Pinus ponderosa_
Rocky Mountain juniper	_Juniperus scopulorum_
Western snowberry	_Symphoricarpos occidentalis_
Squaw currant	_Ribes cereum_
Poison ivy	_Toxicodendron rydbergii_
Plain cottonwood	_Populus deltoides_
Box elder	_Acer negundo_
Hawthorn	_Crataegus_ sp.
Plum	_Prunus americana_
Chokecherry	_Prunus virginiana_
Other	
Muskgrass	_Chara_ sp.
Horned pondweed	_Zannichellia palustris_

APPENDIX 11

Tree and Shrub Seedlings for Revegetation

Common Name	Scientific Name	Seed Mix	Planting Rate[1]
Boxelder	Acer negundo	2, 4	100
Rubber rabbitbrush	Chrysothamnus nauseosus	1, 3	200
Hawthorn	Crataegus sp.	2, 4	300
Russian olive	Elaeagnus angustifolia	1, 2	100
Rocky Mountain juniper	Juniperus scopulorum	1, 3	300
Ponderosa pine	Pinus ponderosa	3	500
Plains cottonwood	Populus deltoides	2, 4	100
American plum	Prunus americana	2, 4	500
Bessey cherry	Prunus besseyi	2, 4	500
Chokecherry	Prunus virginiana	2, 4	500
Skunkbush sumac	Rhus trilobata	1, 3	500
Currant	Ribes sp.	2, 3, 4	500
Wood's rose	Rosa woodsii	1, 2, 4	500
Willow	Salix sp.	2, 4	500
Silver buffaloberry	Shepherdia argentea	2, 4	300
Western snowberry	Symphoricarpos occidentalis	2, 4	500

[1] Number of plants per acre.

APPENDIX 12

Table 12A: Rangeland Seed Mix (Mix No. 1)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
Thickspike wheatgrass	Agropyron dasystachyum	2.00	8.2
Western wheatgrass	Agropyron smithii	3.00	8.6
Slender wheatgrass	Agropyron trachycaulum	1.00	4.1
Little bluestem	Schizachyrium scoparium	1.00	6.8
Sideoats grama	Bouteloua curtipendula	1.00	5.2
Blue grama	Bouteloua gracilis	0.50	11.2
Meadow brome	Bromus bierbersteinii	1.00	2.1
Prairie sandreed	Calamovilfa longifolia	2.00	14.2
Canby bluegrass	Poa canbyi	0.25	6.2
Green needlegrass	Stipa viridula	2.00	9.4
Cicer milkvetch	Astragalus cicer	1.00	3.6
Blue flax	Linum lewisii	0.50	3.8
Alfalfa	Medicago sativa	0.25	1.5
Prairie coneflower	Ratibida columnifera	0.25	8.1
Small burnet	Sanquisorba minor	1.00	1.5
Fourwing saltbush	Atriplex canescens	2.00	2.8
Winterfat	Ceratoides lanata	1.00	3.0
TOTAL		19.75	

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.

Table 12B: Drainage Seed Mix (Mix No. 2)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
Western wheatgrass	Agropyron smithii	3.00	7.7
Slender wheatgrass	Agropyron trachycaulum	3.00	11.2
Blue grama	Bouteloua gracilis	0.50	10.1
Prairie sandreed	Calamovilfa longifolia	2.00	12.8
Switchgrass	Panicum virgatum	1.00	9.2
Big bluegrass	Poa ampla	0.50	10.4
Kentucky bluegrass	Poa pratensis	0.25	12.9
Green needlegrass	Stipa viridula	3.00	8.4
Cicer milkvetch	Astragalus cicer	1.00	3.2
Blue flax	Linum lewisii	1.00	6.8
Alfalfa	Medicago sativa	0.25	1.3
Rocky Mountain penstemon	Penstemon strictus	0.50	3.3
Prairie coneflower	Ratibida columnifera	0.25	2.9
TOTAL		16.25	
OPTIONAL ADDITIONS[3]			
Cudweed sagewort	Artemisia ludoviciana	0.1	--
Silver sagebrush	Artemisia cana	0.5	--
Western snowberry	Symphoricarpos occidentalis	1.0	--

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.
[3]Would be periodically added to fall seedings.

Table 12C: Dry Slopes Seed Mix (Mix No. 3)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
Western wheatgrass	*Agropyron smithii*	4.00	12.3
Little bluestem	*Andropogon scoparius*	1.00	7.3
Prairie sandreed	*Calamovilfa longifiola*	2.00	15.2
Green needlegrass	*Stipa viridula*	2.00	10.7
Bluebunch wheatgrass	*Agropyron spicatum*	3.00	7.8
Sand bluestem	*Andropogon hallii*	2.00	6.1
Sideoats grama	*Bouteloua curtipendula*	2.00	11.1
Canby bluegrass	*Poa canbyi*	0.50	13.1
Cicer milkvetch	*Astragalus cicer*	1.00	3.8
Blue flax	*Linum lewisii*	0.50	4.1
Purple prairie clover	*Petalostemon purpureum*	0.50	4.2
Small burnet	*Sanquisorba minor*	1.00	1.6
Rubber rabbitbush	*Chrysothamnus nauseosus*	0.25	2.8
Skunkbush sumac	*Rhus trilobata*	1.00	0.6
TOTAL		20.75	

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.

Table 12D: Riparian Grass Seed Mix (Mix No. 4)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
Slender wheatgrass	*Agropyron trachycaulum*	3.00	11.0
Big bluestem	*Andropogon gerardii*	3.00	11.0
Little bluestem	*Schizachyrium scoparium*	1.00	6.0
Beardless wildrye	*Elymus triticoides*	2.00	7.1
Basin wildrye	*Elymus cinereus*	2.00	7.8
Prairie sandreed	*Calamovilfa longifolia*	1.00	6.3
Switchgrass	*Panicum virgatum*	2.00	18.2
Reed canarygrass	*Phalaris arundinacea*	0.50	6.2
Kentucky bluegrass	*Poa pratensis*	0.25	12.8
Alkaligrass	*Puccinella distans*	0.25	9.4
Cicer milkvetch	*Astragalus cicer*	1.00	3.2
Wood's rose	*Rosa woodsii*	1.00	1.0
TOTAL		17.00	

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.

Table 12E: Ponderosa Pine Seed Mix (Mix No. 5)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
Bluebunch wheatgrass[3]	Agropyron spicatum	3.0	17.1
Canby bluegrass[4]	Poa canbyi	0.5	19.1
Green needlegrass	Stipa viridula	2.0	14.6
Indian ricegrass	Oryzopsis hymenoides	2.0	11.1
Little bluestem	Andropogon scoparius	1.0	10.5
Sideoats grama	Bouteloua curtipendula	2.0	16.1
Cicer milkvetch	Astragalus cicer	1.0	5.5
Blue flax	Linum lewisii	0.5	5.9
TOTAL		12.0	

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.
[3]Beardless wheatgrass (Agropyron inerme) may be substituted.
[4]Big bluegrass (Poa ampla) may be substituted.

Table 12F: Temporary Reclamation Seed Mixes (Mix No. 6)

Common Name	Scientific Name	Rates[1]	Percent of Mix[2]
	Phase A[3]		
Desert wheatgrass	Agropyron desertorum	4.00	28.8
Thickspike wheatgrass	Agropyron dasystachyum	4.00	23.4
Slender wheatgrass	Agropyron trachycaulum	3.00	18.1
Canada bluegrass	Poa compressa	0.25	23.4
Alfalfa	Medicago sativa	0.75	6.4
TOTAL		12.00	
	Phase B[4]		
Intermediate wheatgrass	Agropyron intermedium	5.00	13.2
Western wheatgrass	Agropyron smithii	5.00	16.6
Slender wheatgrass	Agropyron trachycaulum	4.00	19.1
Meadow brome	Bromus bierbersteinii	5.00	11.9
Kentucky bluegrass	Poa pratensis	0.50	33.1
Alfalfa	Medicago sativa	1.00	6.6
TOTAL		20.50	

[1]Pounds of pure live seed per acre if drilled. Broadcast rates would be twice as high.
[2]Based on number of seeds per square foot.
[3]For use on topsoil stockpiles, roadsides, facilities, and sediment ponds.
[4]For use in drainage ditches.

Table 12G: Supplemental Forb and Shrub Seeds (Mix No. 3)

Common Name	Scientific Name
Forbs	
Common yarrow	Achillea millefolium
Cudweed sagewort	Artemisia ludoviciana
Pacific aster	Aster chilensis
Arrowleaf balsamroot	Balsamorhiza sagittata
Harebell	Campanula rotundifolia
Indian paintbrush	Castilleja linariaefolia
Purple coneflower	Echinacea angustifolia
Sulfur buckwheat	Eriogonum umbellatum
Common gaillardia	Gaillardia aristata
Northern sweetvetch	Hedysarum boreale
Maximilian sunflower	Helianthus maximiliani
Silky lupine	Lupinus sericeus
Wasatch penstemon	Penstemon cyananthus
Black-eyed Susan	Rudbeckia hirta
Stiff goldenrod	Solidago rigida
Scarlet globemallow	Sphaeralcea coccinea
Shrubs	
Silver sagebrush	Artemisia cana
Fringed sagewort	Artemisia frigida
Big sagebrush	Artemisia tridentata
Shadscale saltbush	Atriplex confertifolia
Rubber rabbitbrush	Chrysothamnus nauseosus
Golden currant	Ribes aureum
Squaw currant	Ribes cereum
Western snowberry	Symphoricarpos occidentalis

Note: Some species may be added to revegetation seed mixes.

APPENDIX 13

Common and Scientific Names of Wildlife Species

Common Name	Scientific Name
Mammals	
Mule deer	*Odocoileus hemionus*
Pronghorn	*Antilocapra americana*
Coyote	*Canis latrans*
Bobcat	*Lynx rufus*
Long-tailed weasel	*Mustela frenata*
Badger	*Taxidea taxus*
Striped skunk	*Mephitis mephitis*
White-tailed jackrabbit	*Lepus townsendii*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Cottontail	*Sylvilagus* sp.
Porcupine	*Erethizon dorsatum*
Red squirrel	*Tamiasciurus hudsonicus*
Yellow-bellied marmot	*Marmota flaviventris*
Least chipmunk	*Eutamias minimus*
Deer mouse	*Peromyscus maniculatus*
Western harvest mouse	*Reithrodontomys megalotis*
Meadow vole	*Microtus pennsylvanicus*
Sagebrush vole	*Lagurus curtatus*
Western jumping mouse	*Zapus princeps*
Bushy-tailed woodrat	*Neotoma cinerea*
Black-footed ferret	*Mustela nigripes*
Birds	
Sharp-tailed grouse	*Pediocetes phasianellus*
Wild turkey	*Meleagris gallopavo*
Gray partridge	*Perdix perdix*
Ring-necked pheasant	*Phasianus colchicus*
Mallard	*Anas platyrhynchos*
Canada goose	*Branta canadensis*
Green-winged teal	*Anas carolinensis*
Blue-winged teal	*Anas discors*
American wigeon	*Mareca americana*
Golden eagle	*Aquila chrysaetos*
Turkey vulture	*Cathartes aura*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
Cooper's hawk	*Accipiter cooperii*
Sharp-shinned hawk	*Accipiter striatus*
Merlin	*Falco columbarius*
American kestrel	*Falco sparverius*
Prairie falcon	*Falco mexicanus*
Northern harrier	*Circus cyaneus*

Common Name	Scientific Name
Osprey	Pandion haliaetus
Great horned owl	Bubo virginianus
Long-eared owl	Asio otus
Chipping sparrow	Spizella passerina
Red crossbill	Loxia curvirostra
Rock wren	Salpinctes obsoletus
Western meadowlark	Sturnella neglecta
Yellow warbler	Dendroica petechia
Brewer's blackbird	Euphagus cyanocephalus
Bald eagle	Haliaeetus leucocephalus
Peregrine falcon	Falco peregrinus
Reptiles	
Garter snake	Thamnophis radix
Prairie rattlesnake	Crotalus viridis
Bull snake	Pituophis melanoleucus
Hognose snake	Heterodon nasicus
Sagebrush lizard	Sceloporus graciosus

CHAPTER VII:

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CHAPTER VIII:

GLOSSARY

Aeolian Soils - Soils composed of deposition of wind-borne materials.

Alluvium - Soil and geological parent material that is deposited by flowing water.

Aquitard - A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer.

Channery - Soil with 15 to 20 percent or greater of flat rock fragments up to 6 inches long.

Colluvium - Fragments of rock carried and deposited by gravity.

Cropline - Area at ground surface where coal seam is exposed.

Evapotranspiration - The release of water to the atmosphere by vegetation.

Fluventic Soil - Soil derived from alluvial geological parent material.

Headcut - Erosion that progresses upstream in a drainageway.

Highwall - Vertical or near-vertical face of mine pit remaining after mining.

Interburden - Subsoil geological materials between the Rosebud and McKay coal seams.

Lithology - Physical characteristics of rock.

Overburden - Subsoil geological material overlying a coal seam.

Piping - Erosion by pecolating water in a layer of subsoil resulting in caving and in the formation of narrow conduits, tunnels, or "pipes" through which soluble or granular material is removed.

Residual Soils - Soils that have developed in place from underlying rock and parent material.

Spoils - Geological material excavated during mining.

Soil Series - A group of soils developed from the same kind of parent material, by similar processes, and with similar chemical and physical characteristics.

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